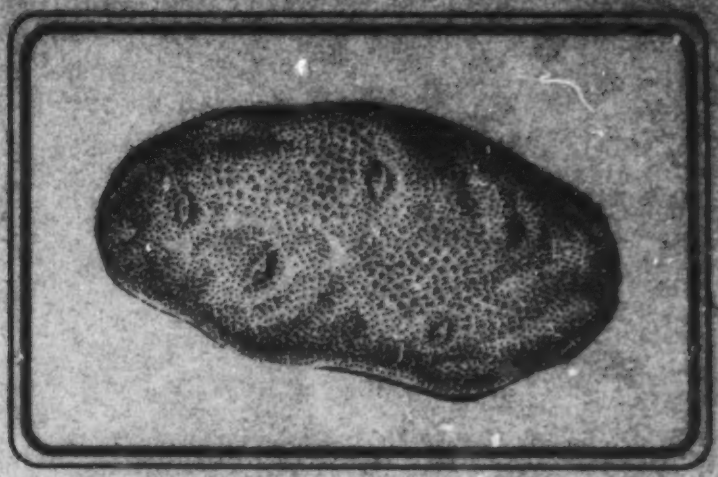
VOL. 2

1989



TECHNICAL REPORTS ON POTATOES
RAPPORTS TECHNIQUES SUR LES POMMES DE TERRE

POTATO CENTRE
CENTRE DE LA POMME DE TERRE
NEW BRUNSWICK DEPARTMENT OF AGRICULTURE
MINISTERE DE L'AGRICULTURE DU NOUVEAU-BRUNSWICK

New Nouveau Brunswick

VOL. 2

1989 TECHNICAL REPORTS ON POTATOES

RAPPORTS TECHNIQUES DE 1989 SUR LES POMMES DE TERRE

POTATO CENTRE
CENTRE DE LA POMME DE TERRE
NEW BRUNSWICK
DEPARTMENT OF AGRICULTURE
MINISTERE DE L'AGRICULTURE DU
NOUVEAU-BRUNSWICK

Robert W. Saintonge
Deputy Minister
Sous-Ministre

Alan R. Graham
Minister of Agriculture
Ministre de l'Agriculture

INTRODUCTION

This is the second report to be published on applied research, surveys and demonstrations dealing strictly with potato production in New Brunswick.

I wish to thank all the specialists who submitted papers, for their effort; the potato growers whose land and machinery were used, for their collaboration; and the organizations who provided funding, for their much needed financial support.

I also wish to acknowledge the contribution of specialists from the Plant Industry Branch and the North-West Region.

INTRODUCTION

Voici le deuxième rapport à être publié, qui traite de recherche appliquée d'enquêtes et de démonstrations concernant strictement la production de pomme de terre au Nouveau-Brunswick.

Je veux remercier pour leurs efforts, tous les spécialistes ayant contribué des rapports; pour leur collaboration, tous les producteurs ayant participé aux projets; et pour leur support, toutes les organisations qui nous ont fourni une aide monétaire.

Je veux aussi souligner la contribution de spécialistes de la Direction de l'industrie végetale et de la région du Nord-Ouest.

Peter S. Jones
Director/Directeur

TABLE OF CONTENTS

TABLE DES MATIÈRES

1.	The 1989 Growing Season Saison de croissance 1989	George S. Read	1
2.	Evaluation of Promising Russet Potato Varieties and the Development of their Management Profile for the Count Carton Trade Évaluation des variétés de pommes de terre prometteuses de type Russet et développement de profil de régie agronomique de ces variétés destinées à l'emballage dans des boîtes de carton	Ghislain Pelletier	13
3.	The effect of Seed Spacing and irregular in-row spacing on Shepody yield Étude de l'effet de l'espacement et de la non-uniformite du placement de la semence Shepody	Ghislain Pelletier	37
4.	Observations on the use of a inter-row rotary cultivator in Potato Production Observations sur l'utilisation d'une butteuse à crochets dans la production de la pomme de terre	Ghislain Pelletier	41
5.	A Preliminary Evaluation of the Use of Erosion Control Mats for Grassed Waterway Construction in New Brunswick Une évaluation préliminaire de l'utilisation de tapis anti-érosion lors de la construction de voies d'eaux engazonnées au Nouveau-Brunswick	Clair Gartley J. L. Daigle Walter Allison	48

6.	Aerial Monitoring of Potato Infesting Aphids in New Brunswick in 1989 Enquête sur les vols de pucerons infestant les pommes de terre au Nouveau-Brunswick en 1989	Guy Bernard	58
7.	Monitoring of Insect Populations in Potato Fields in 1989 Enquête sur les infestations d'insectes dans les champs de pommes de terre en 1989	Guy Bernard	63
8.	Inspection of Greenhouses for the presence of Potato Infesting Aphids in 1989 Inspection des serres en 1989, pour la presence de pucerons infestant les pommes de terre	Guy Bernard	73
9.	Evaluation of Bacillus Thuringiensis Formulations for the Control of Colorado Potato Beetles Évaluation de différentes formulations de Bacillus thuringiensis pour le contrôle du doryphore de la pomme de terre	Guy Bernard	75
10.	Effect of Topkill Date on Yield of Desirée Cultivar Seed Potatoes Effet de la date de défanage sur le rendement du cultivar de pommes de terre de semence Desirée	R. P. Hinds A. F. Perley	83
11.	Effect of Gypsum on Yield and Scab Incidence in the Potato Cultivar Kennebec Effet du gypse sur le rendement du cultivar de pommes de terre Kennebec et sur la fréquence des cas de gale	R. P. Hinds A. F. Perley	87
12.	Green Manure - Gypsum Effects on Yield and Scab Incidence in the Potato Cultivar Shepody Effet de l'engrais vert et du gypse sur le rendement des cultivars de pommes de terre Shepody et sur la fréquence des cas de gale	R. P. Hinds A. F. Perley	93

13.	Field Observations on the Rumptstad Four-Row Ridge Shaper versus Conventional Hilling in the Production of Russet Burbank Potato Cultivar Observations sur l'utilisation d'une charrue butteuse Rumptstad à 4 butteurs et d'une méthode conventionnelle de buttage pour la production de cultivars de pommes de terre Russet Burbank	R. P. Hinds	96
14.	Effect of Gypsum on Yield and Scab Incidence in the Potato Cultivar Shepody Effet du gypse sur le rendement du cultivar de pommes de terre Shepody et sur la fréquence des cas de gale	R. P. Hinds A. F. Perley	100
15.	Response of Russet Burbank Potato Cultivar to Different Calcium Treatments Réaction de cultivars de pommes de terre Russet Burbank à divers traitements au calcium	R. P. Hinds A. F. Perley	108
16.	Preliminary Observations on Yield and Scab Incidence of Yukon Gold Potato Cultivar as affected by Gypsum/Green Manure Treatments Observations préliminaires sur le rendement de cultivars de pommes de terre Yukon et sur la fréquence des cas de gale à la suite de traitements au gypse et à l'engrais vert	R. P. Hinds A. F. Perley	115

THE 1989 GROWING SEASON

George Read

ABSTRACT: The 1989 Growing season was characterized by variable conditions. The eastern half of the province was for the most part drier than the western half. Heat units were near normal and the frost incidence generally reflected normal spring frosts and slightly early fall frosts.

SAISON DE CROISSANCE 1989

Résumé: La saison de croissance 1989 a été caractérisée par des conditions atmosphériques variables. Le climat était plus sec dans la moitié est de la province que dans la moitié ouest. Les unités thermiques étaient près de la normale et l'observation du gel indique qu'en général, les gels printaniers étaient normaux et les gels automnals ont été assez hâtifs.

INTRODUCTION: Generalizing the weather conditions for and entire province for an entire season does not explain crop performance on individual farms or even separate regions for the most part. The climate of farms varies significantly from one location to another with such things as frost occurrence, crop development, planting, insect and disease development or harvesting operations. It is therefore necessary to evaluate specific varieties, recommendations and production practices with the most localized or representative information as possible.

Despite these farm scale influences, the overall performance of crops on a provincial scale can often be correlated with major deviations from normal growing season conditions, such as droughts, wet periods, extensive frosts or unusually warm or cold seasons. With these factors recognized, a general summary of the 1988 cropping season weather is presented.

SUMMARY: The precipitation in the month of May was generally characterized by a wet Saint John river valley in the western part of the province running from Saint John to Grand Falls, including St. Stephen, Gagetown, Fredericton, Woodstock, and Centreville, which were well above normal. The eastern half of the Province was generally dry from Moncton in the South to Chatham in the North. Growing degree-days were well above normal all over the Province, often as high as fifty percent greater than normal.

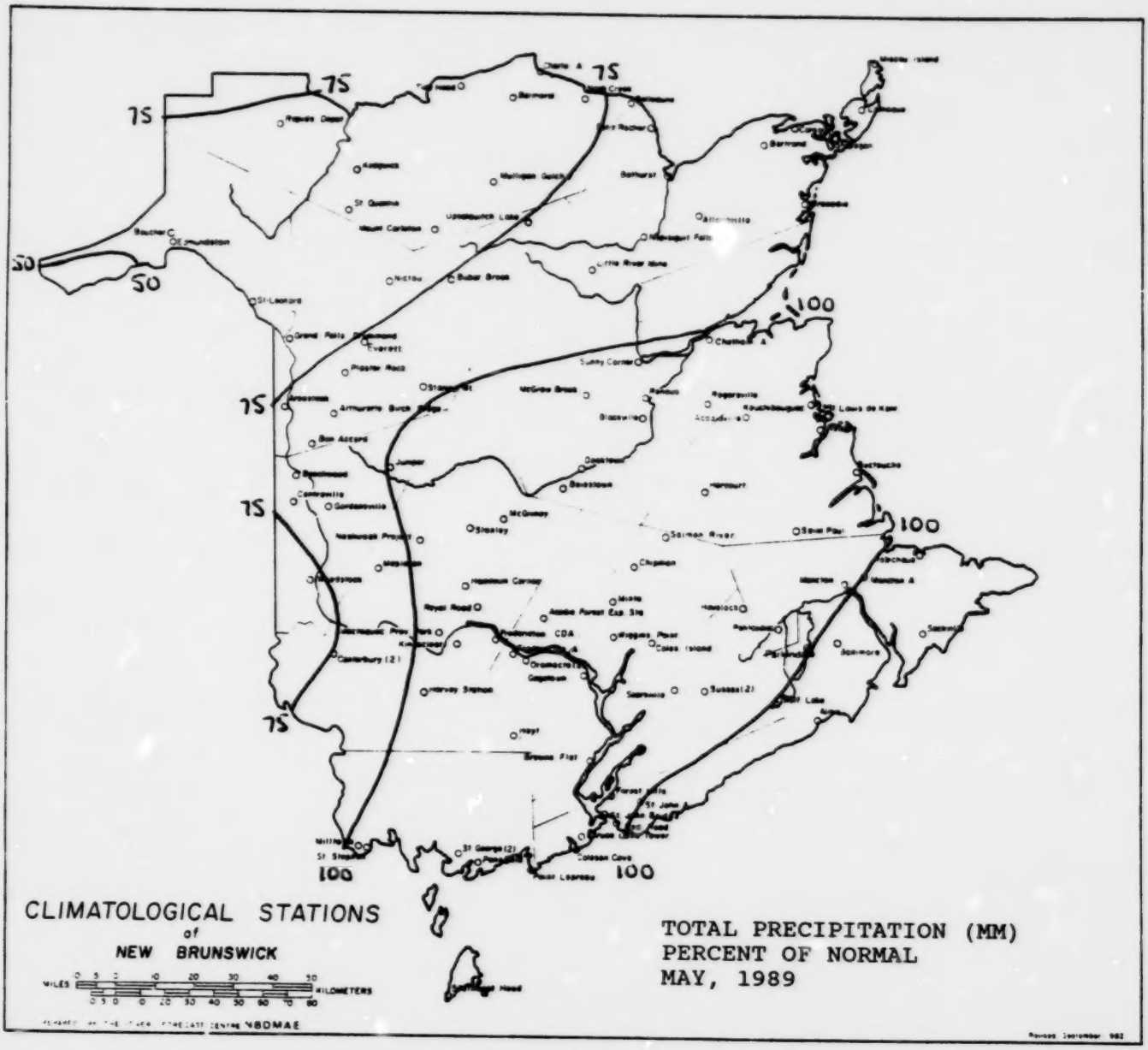
June continued with warm temperatures and fairly well distributed rainfall. Most locations reported slightly below normal amounts however the Eastern part of the Province continued with dry conditions from Moncton through to The Acadian Peninsula.

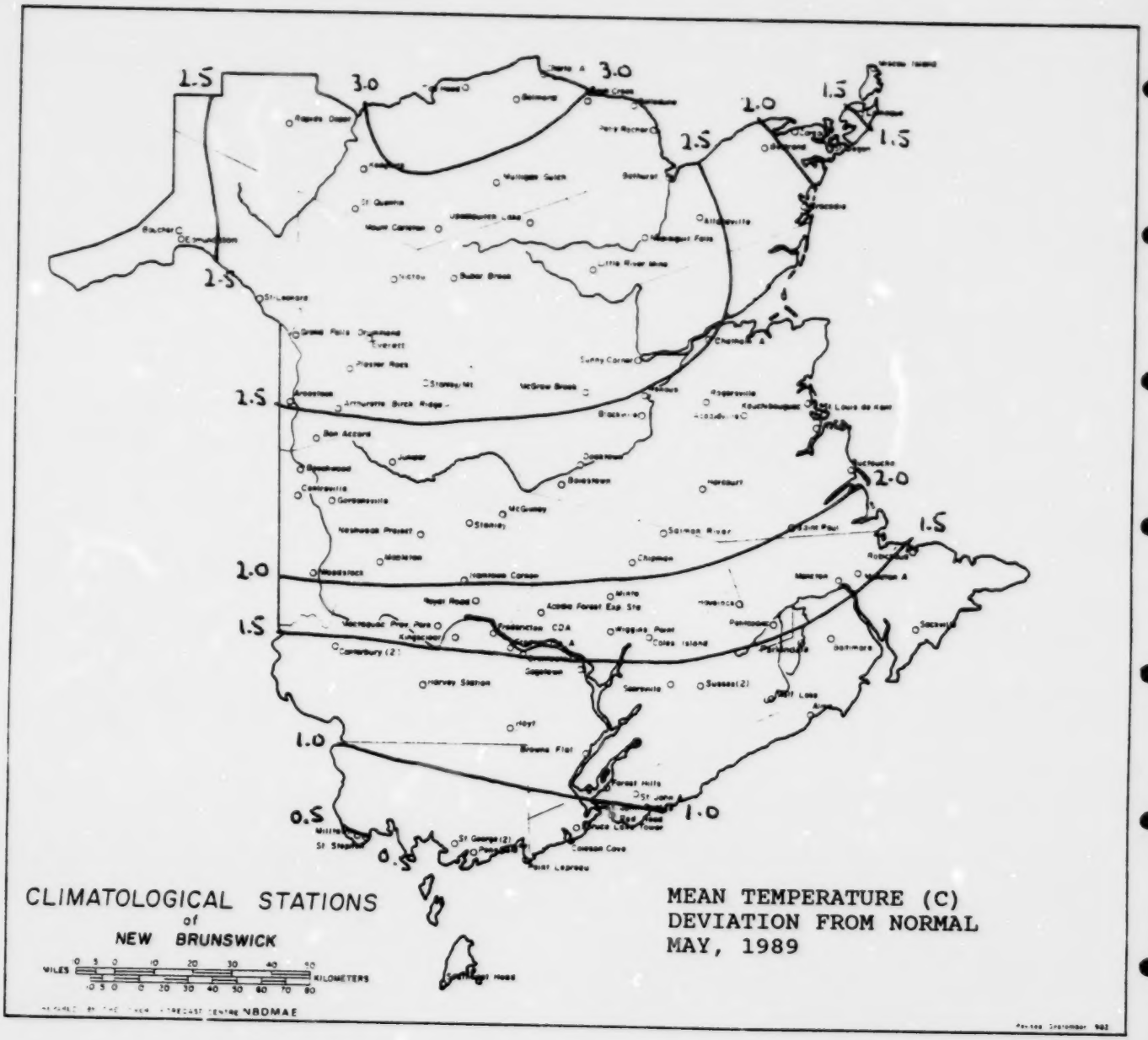
Temperatures were still above normal in July, approximately 10 per cent. The month was wet in the North and dry in the South.

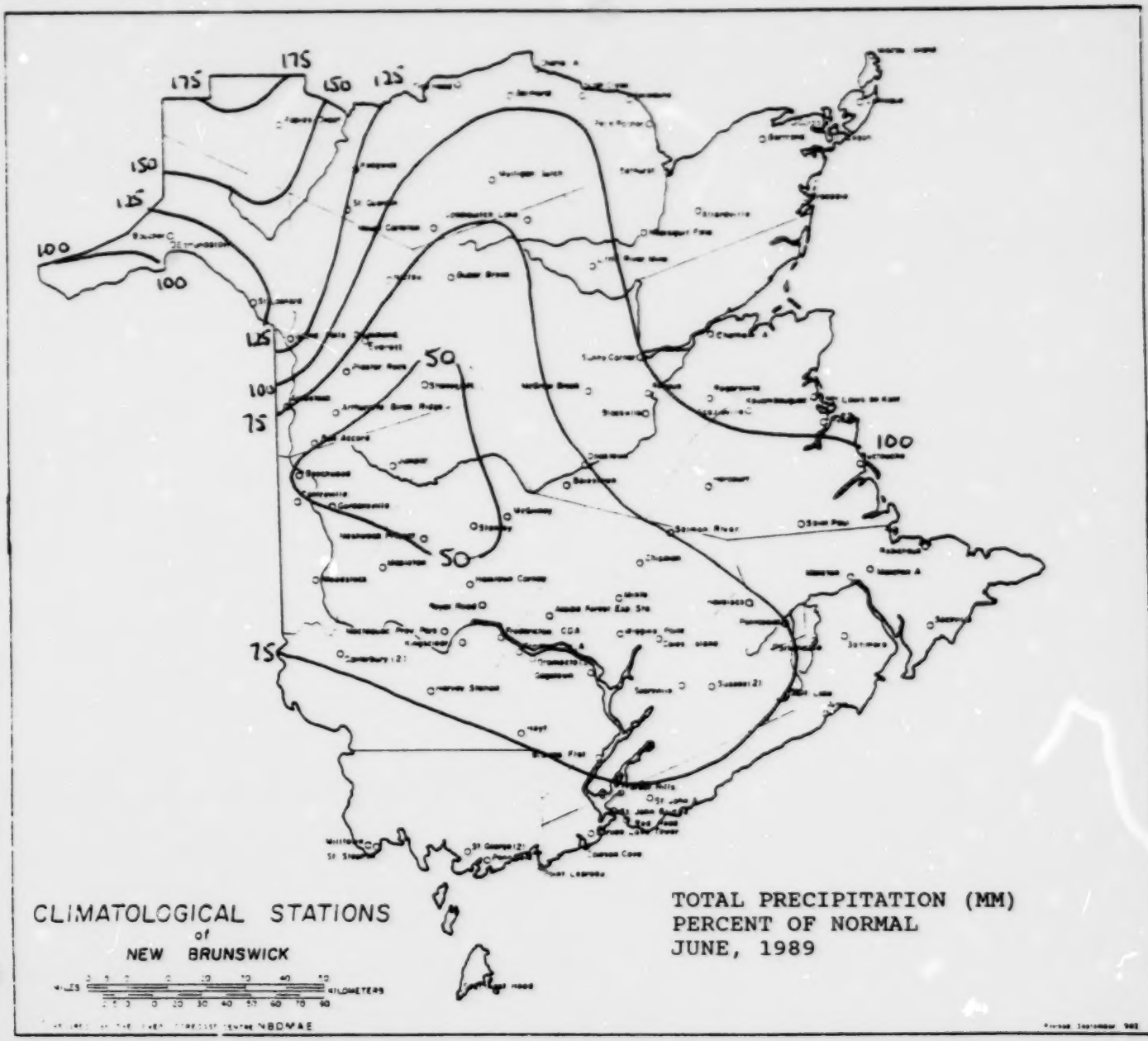
August was highlighted by exceptionally heavy rains and storms. Approximately 155 mm. of rain fell in Fredericton over a 36 hour period. The total rainfall for the month at some locations was double the normal amount. However, Moncton, Sussex, and Charlo were all below normal.

September was near normal conditions with rain hampering harvest activities the latter part of the month in Woodstock. Frost was evident from early-month onwards.

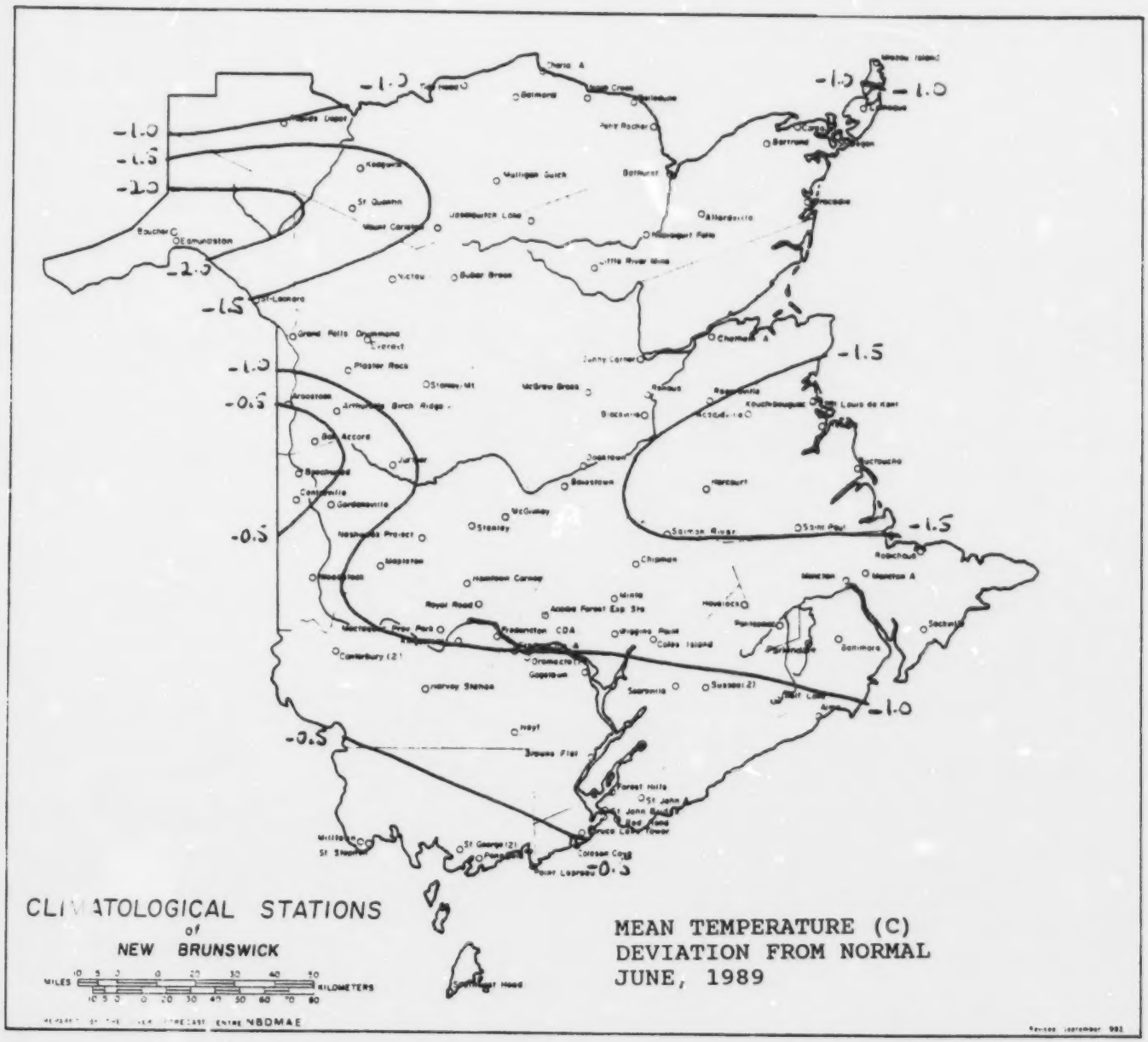
MAPS: The following maps, courtesy of the New Brunswick Department of the Environment and Environment Canada, depict temperature and precipitation values as a per cent of normal for the months of May, June, July, August, and September for 1989. The results are based on unverified reports.

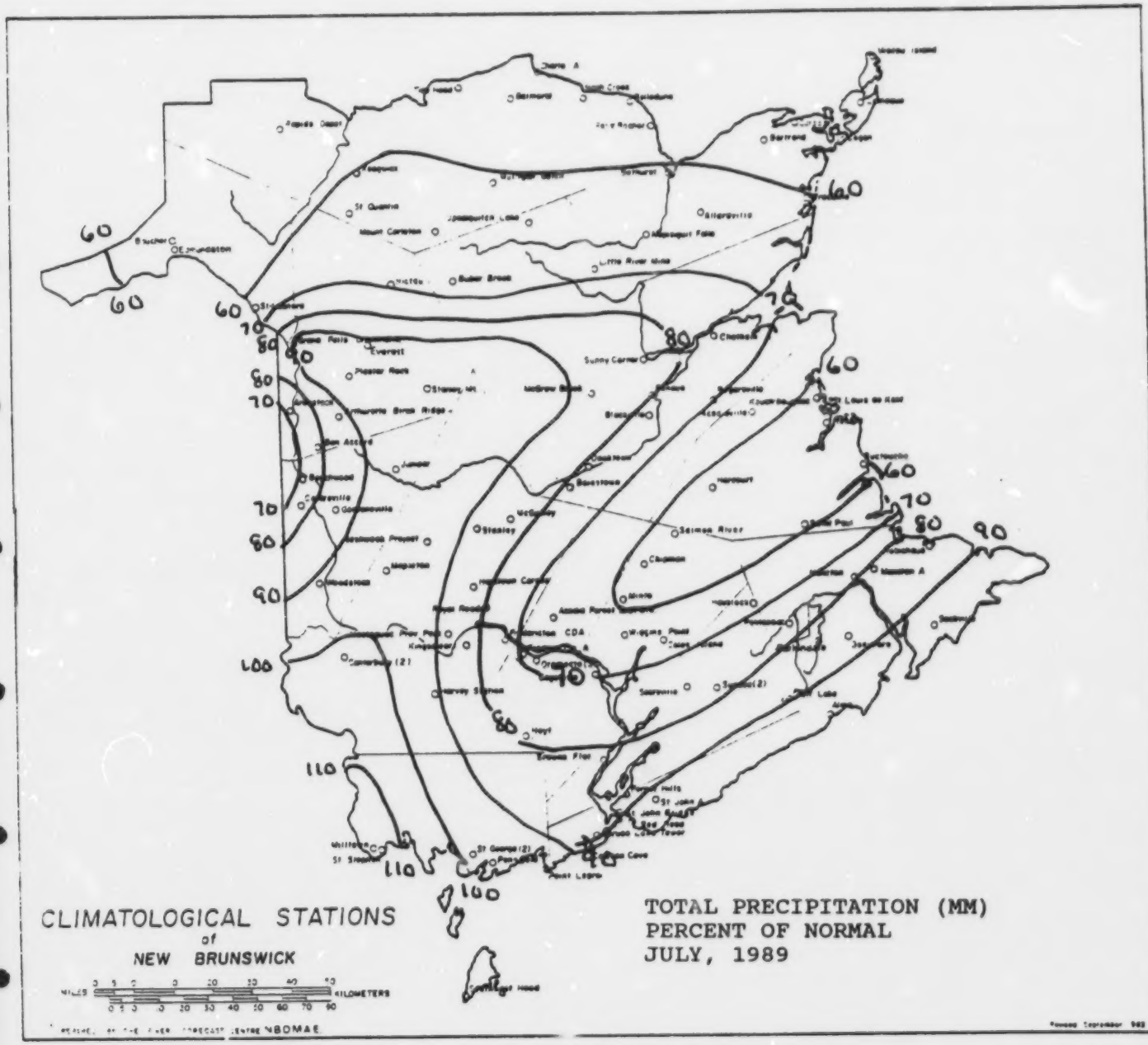

75
75
75
75
75
50
50
100
100
100
CLIMATOLOGICAL STATIONS
of
NEW BRUNSWICK
MILES
KILOMETERS
TOTAL PRECIPITATION (MM)
PERCENT OF NORMAL
MAY, 1989

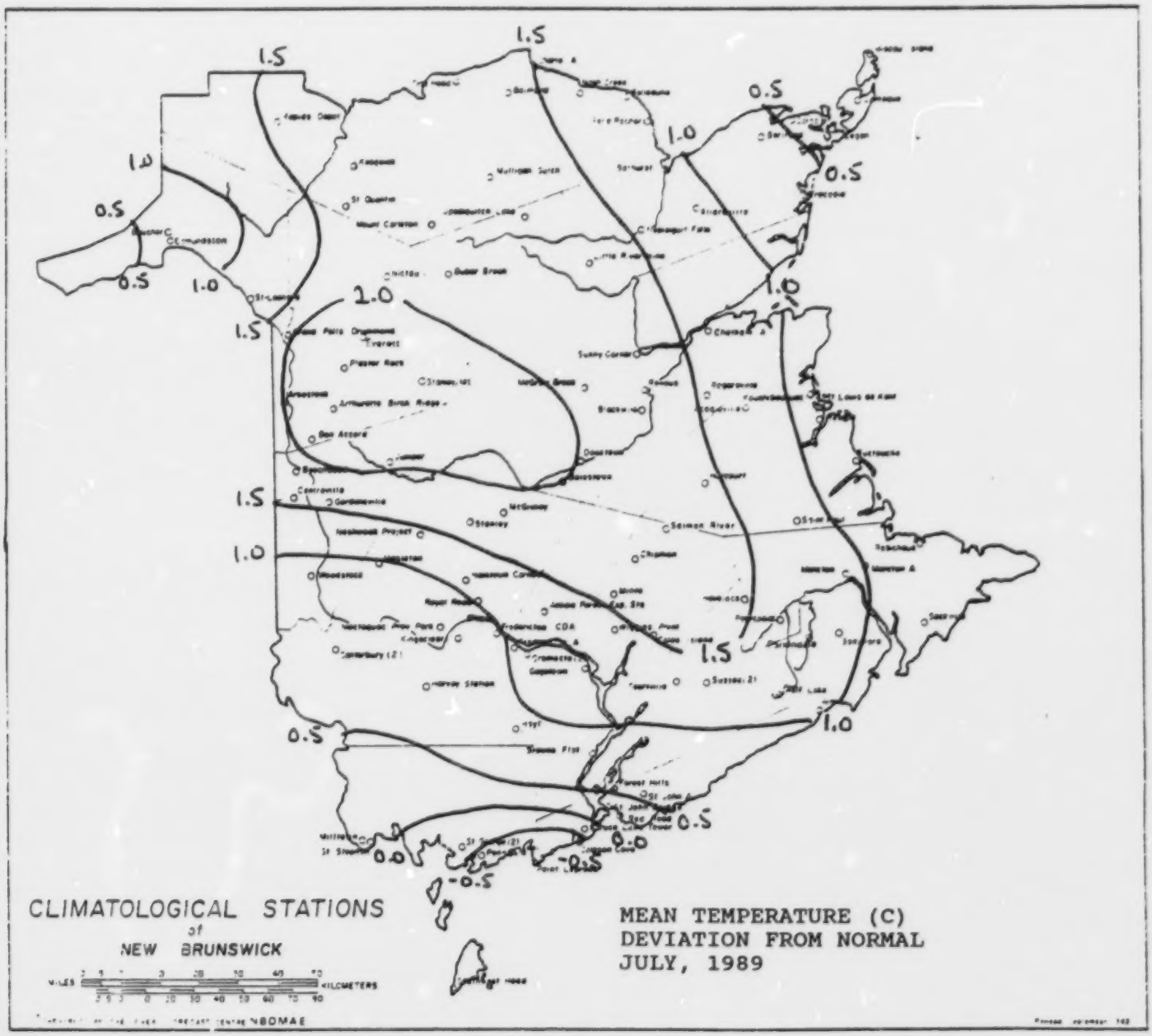

1.5
3.0
3.0
2.0
1.5
2.5
1.5
2.5
2.5
2.0
1.5
2.0
1.5
1.0
0.5
0.5
1.0
CLIMATOLOGICAL STATIONS
of
NEW BRUNSWICK
MILES
KILOMETERS
MEAN TEMPERATURE (C)
DEVIATION FROM NORMAL
MAY, 1989

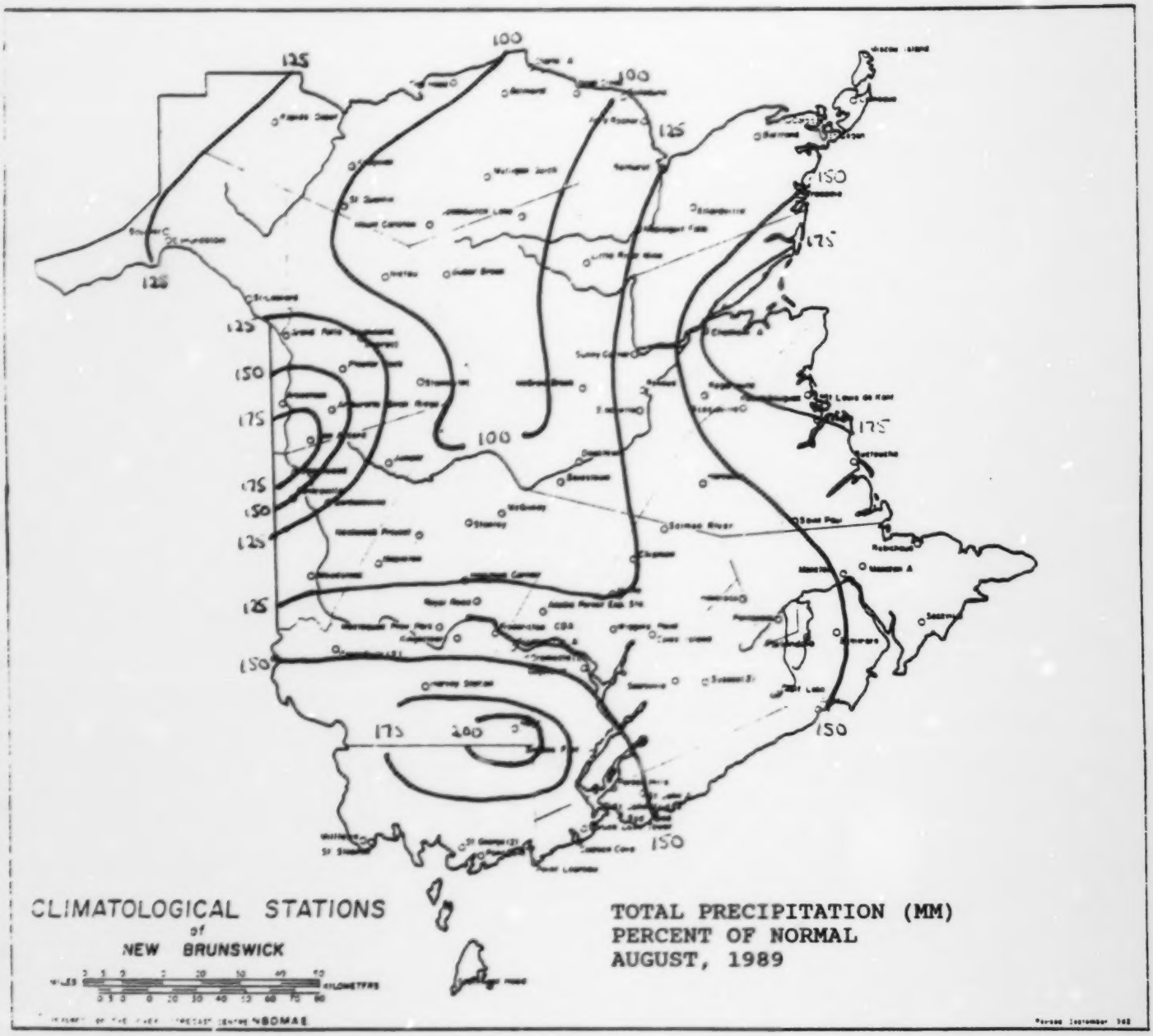


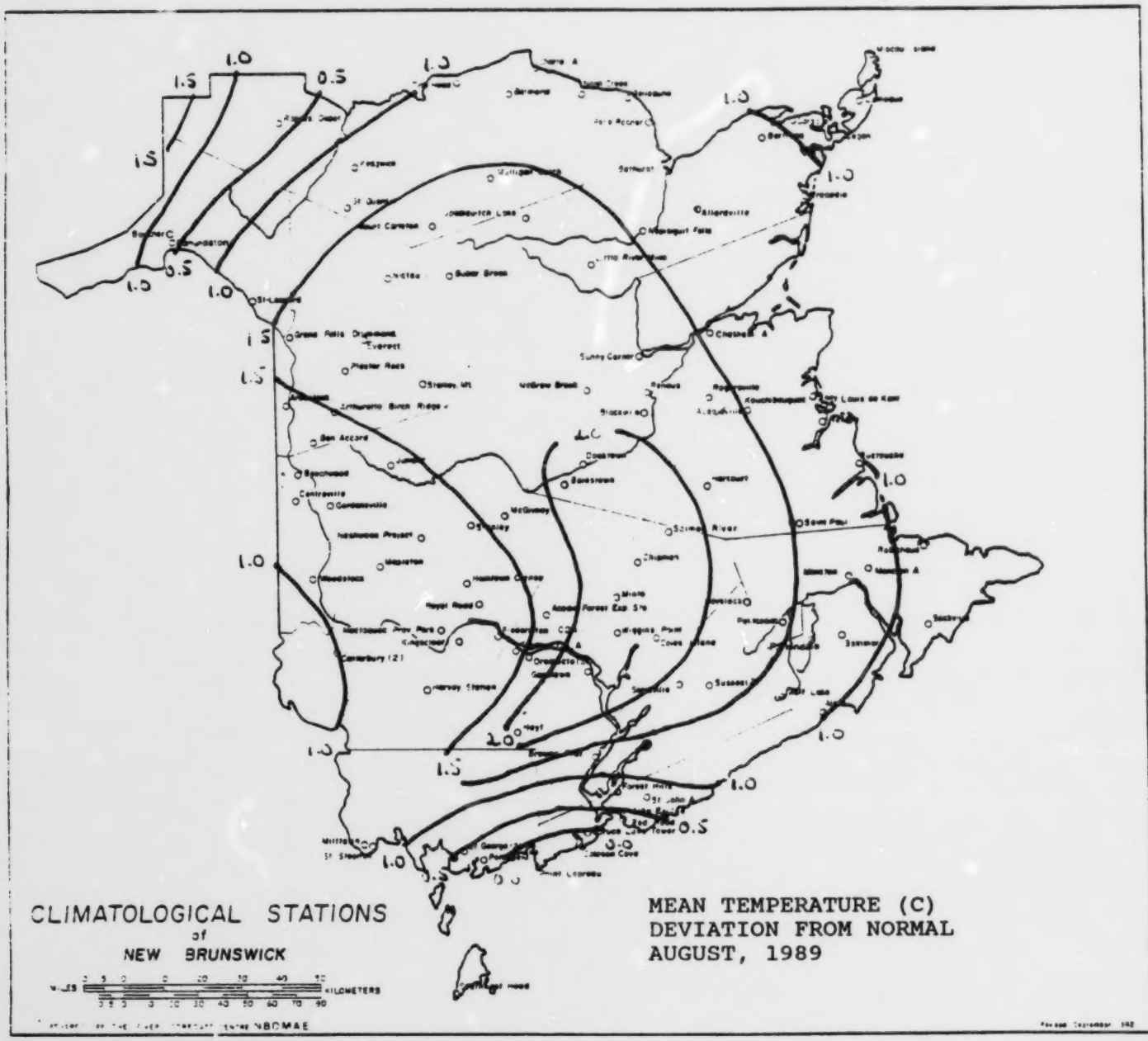
TOTAL PRECIPITATION (MM)
PERCENT OF NORMAL
JUNE, 1989

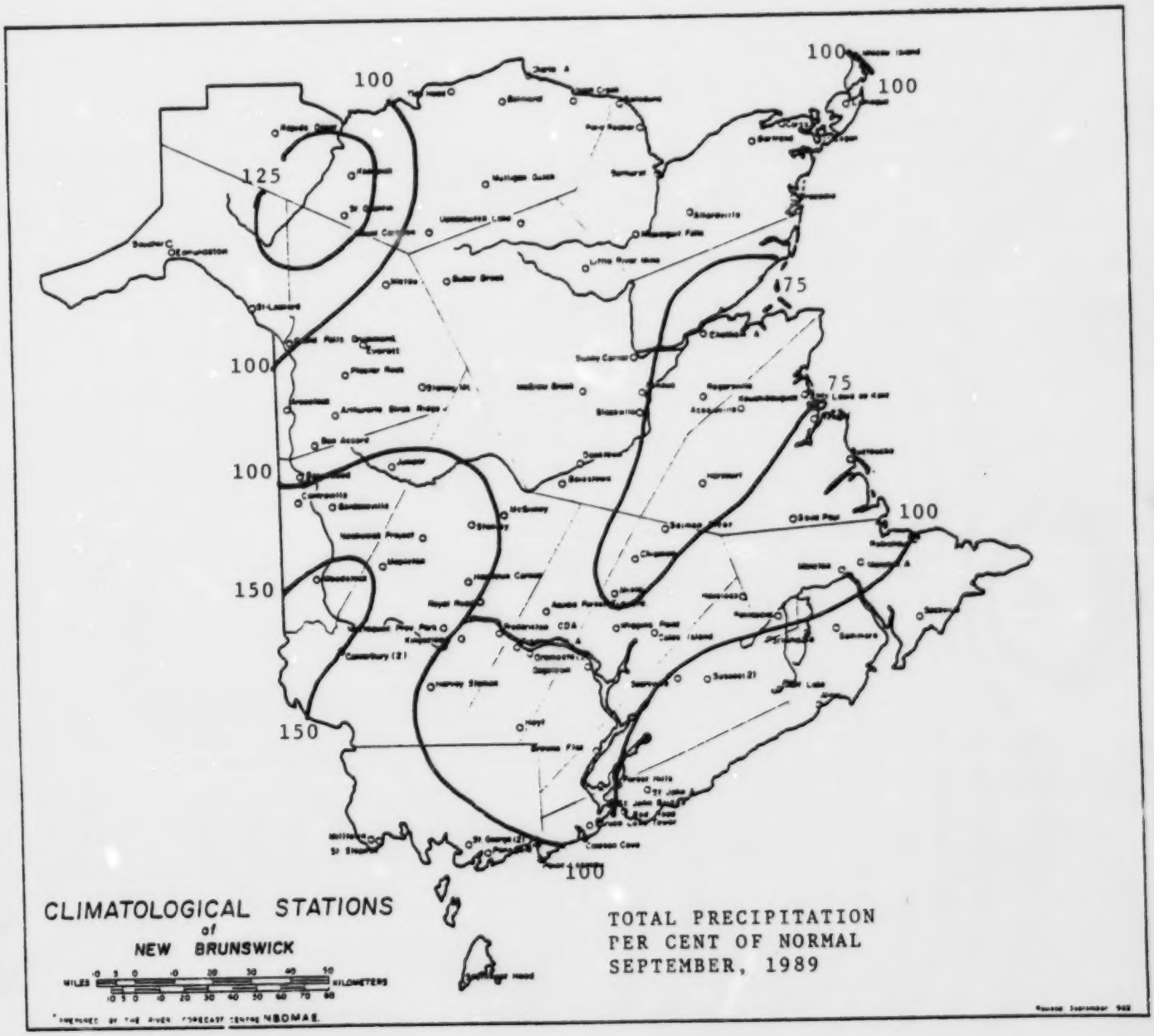

-1.0
-1.5
-2.0
-0.5
CLIMATOLOGICAL STATIONS
of
NEW BRUNSWICK
MILES
KILOMETERS
MEAN TEMPERATURE (C)
DEVIATION FROM NORMAL
JUNE, 1989

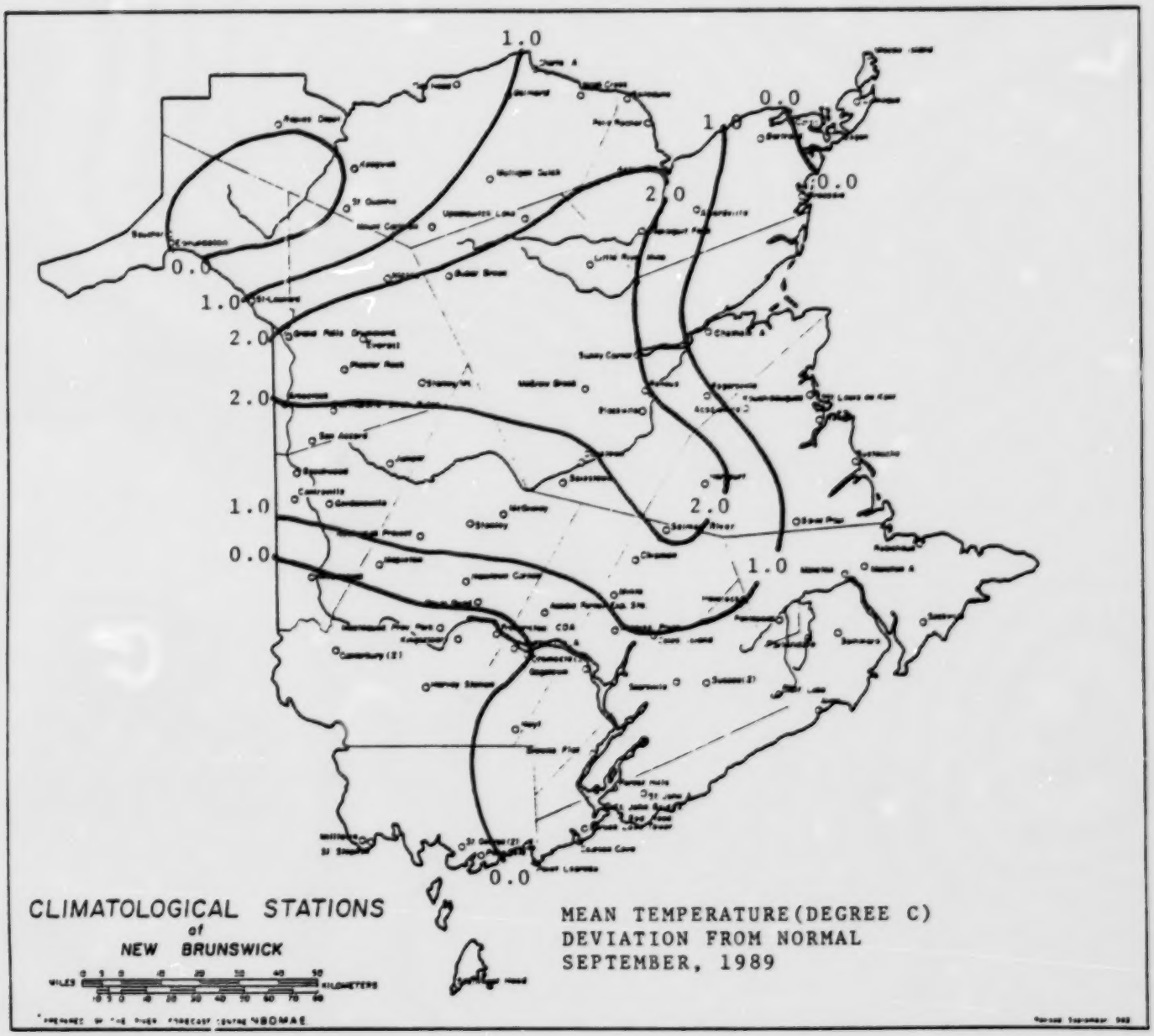

60
60
60
70
80
80
70
70
80
90
100
110
110
100
60
60
70
80
90
80
70
80
90
CLIMATOLOGICAL STATIONS
of
NEW BRUNSWICK
TOTAL PRECIPITATION (MM)
PERCENT OF NORMAL
JULY, 1989


1.5
1.5
0.5
1.0
0.5
0.5
1.0
2.0
1.5
1.5
1.0
0.5
0.0
0.0
-0.5
-0.5
1.0
0.5
1.0
1.5
1.0
0.5
0.5
CLIMATOLOGICAL STATIONS
of
NEW BRUNSWICK
MILES
KILOMETERS
MEAN TEMPERATURE (C)
DEVIATION FROM NORMAL
JULY, 1989


100
125
100
125
150
175
125
150
175
125
150
125
125
150
175
200
150
150
CLIMATOLOGICAL STATIONS
of
NEW BRUNSWICK
TOTAL PRECIPITATION (MM)
PERCENT OF NORMAL
AUGUST, 1989


CLIMATOLOGICAL STATIONS
of
NEW BRUNSWICK
MEAN TEMPERATURE (C)
DEVIATION FROM NORMAL
AUGUST, 1989
NBDMAE


100
100
100
125
75
100
75
100
150
100
150
100
CLIMATOLOGICAL STATIONS
of
NEW BRUNSWICK
MILES
KILOMETERS
TOTAL PRECIPITATION
PER CENT OF NORMAL
SEPTEMBER, 1989


1.0
0.0
1
0.0
2.0
0.0
1.0
2.0
2.0
1.0
2.0
0.0
1.0
0.0
CLIMATOLOGICAL STATIONS
of
NEW BRUNSWICK
MEAN TEMPERATURE(DEGREE C)
DEVIATION FROM NORMAL
SEPTEMBER, 1989

EVALUATION DES VARIÉTÉS DE POMMES DE TERRE PROMETTEUSES DE TYPE RUSSET ET DÉVELOPPEMENT DE PROFIL DE RÉGIE AGRONOMIQUE DE CES VARIÉTÉS DESTINÉES À L'EMBALLAGE DANS DES BOÎTES DE CARTON

par

Ghislain J. Pelletier

RÉSUMÉ:

Une étude a été entreprise afin de déterminer le potentiel de rendement des variétés de pommes de terre prometteuses de type russet et de développer des profils de régie agronomique de ces variétés destinées à l'emballage dans des boîtes de carton.

Deux essais de maturité, hâtive et tardive, ont été établis dans la région de Grand-Sault au printemps 1989. L'essai de maturité hâtive qui a été fertilisé avec 152 kg/ha de NPK et défané 105 jours après la plantation comprenait les variétés suivantes: Russet Norkotah, Centennial Russet, Coastal Russet, HiLite Russet, GoldRus et Russet Burbank comme témoin. L'essai de maturité tardive qui comprenait les variétés A7411-2, Russette, Russet Norkotah, HiLite Russet, BelRus et Russet Burbank à titre de témoin a reçu 185 kg/ha de NPK et a été défané 125 jours après la plantation.

Trois espacements de plantation de 25.4, 33.0 et 40.6 cm sur des rangs distancés à 91 cm ont été utilisés pour chacune des variétés.

Les rendements vendables de Russet Norkotah, HiLite Russet et Russette ont été significativement supérieurs à celui de Russet Burbank. Les rendements de la catégorie emballage dans des boîtes de carton pour les variétés Russet Norkotah, HiLite Russet, Russette et A7411-2 ont été supérieurs à celui de Russet Burbank. Seul la variété BelRus a donné un rendement inférieur à Russet Burbank dans cette catégorie.

L'utilisation de différents espacement de plantation n'a pas donné de différences significatives sur les rendements vendables. Cependant, des rendements supérieurs dans la catégorie emballage dans des boîtes de carton ont été obtenus avec les plus grands espacements.

Les résultats de cette année et de l'année dernière de la variété Russet Norkotah ont été utilisés pour élaborer un profil de régie agronomique préliminaire pour cette variété.

EVALUATION OF PROMISING RUSSETED POTATO VARIETIES AND THE DEVELOPMENT OF THEIR PRODUCTION MANAGEMENT PROFILE FOR THE COUNT CARTON TRADE.

by

Ghislain J. Pelletier

SUMMARY:

A study was undertaken to assess the yielding capabilities of promising russeted potato varieties and to develop production management profiles for those varieties.

Two maturity trials, early and late, were established in Grand Falls during the spring of 1989. The early maturity trial which was fertilized with 152 kg/ha of NPK and topkilled 105 days after planting consisted of the following varieties: Russet Norkotah, Centennial Russet, Coastal Russet, HiLite Russet, GoldRus and Russet Burbank as a check. The late maturing trial which consisted of A7411-2, Russette, Russet Norkotah, HiLite Russet, BelRus and Russet Burbank as check, received 185 kg/ha of NPK and was topkilled 125 days after planting. Three in-row spacings of 25.4, 33.0 and 40.6 cm were used for each varieties on rows of 91 cm apart.

Marketable yields for Russet Norkotah, HiLite Russet and Russette were significantly higher than for Russet Burbank. Count size yields for Russet Norkotah, HiLite Russet, Russette and A7411-2 were all higher than for Russet Burbank. Only BelRus gave lower count carton size yield than Russet Burbank.

Marketable yields were generally unaffected by the use of various spacing. However, count size yields were higher with greater spacings.

The results of this year and last year for Russet Norkotah were used to draft a preliminary production management profile.

INTRODUCTION:

The volume of New Brunswick table potato shipments has decreased substantially in the last two decades. While table potato shipments represented 122472 metric tonnes in 1963-64, they represented only 56700 metric tonnes in 1986-87.

Not only has this market segment decreased in volume, but it has also seen a modification as to the type of product being marketed. This became necessary to better suit the expansion demands of the food service industry resulting from the shifts in consumer demands for food away from home and the greater expectation of the consumers for the cleanliness of the product. Restaurants and Institutions (January 1988) reports that for the year 1987 in the U.S., consumers' spending for food away from home represented 46%

share of total food expenditures. This represents an increase of 20 percentage points from 1960 when the food service industry accounted for 25% of total food expenditures. As to the type of potatoes being consumed fresh, the National food review (1986) reported that the russet potato is the most popular fresh potato among consumers.

In the last years, we have seen an increase in the number of New Brunswick packing facilities with washing capabilities. Most of these also have the capability to pack potatoes in count boxes for the H.R.I. trade. This particular market segment has requirements that are not easily met. Firstly, there is a size requirement. Tubers in count boxes need to be at least 227 g in size. Secondly, because the product is being washed, all blemishes caused by mechanical damages and tuber diseases are much more visible.

Russet Burbank has been used extensively in New Brunswick for this market. This particular variety requires a long growing season to reach its full yield and maturity potentials. It also has the unwanted characteristics of producing off shape tubers when subjected to lack of moisture in the growing season. The amount of off shape tubers produced in some seasons is such that the proportion of grade defects is excessive and it represents a loss for the producer.

The earlier maturing variety BelRus has also been produced for the H.R.I. market with limited success. It's susceptibility to early dying prevents its tubers from reaching a desirable size.

There are other promising russeted potato varieties recently released by breeding programs in North America: Russet Norkotah and Coastal Russet, to name two, are varieties that have caught the interest of several growers.

In order for the New Brunswick table stock potato industry to capture its share of the H.R.I. market, the new varieties and other promising ones need to be evaluated under the province's growing conditions.

The objectives of this project were to evaluate several new promising russeted potato varieties and to determine how yield and tuber size of these selections respond to seed piece spacing. The information gathered will be used to develop production management profiles for the most promising varieties.

MATERIALS AND METHODS:

Two maturity trials were conducted each with six varieties. Three of the varieties were grown in both trials so that in total 9 russeted potato selections were evaluated.

The early maturity trial included Russet Norkotah, Centennial Russet, Coastal Russet, HiLite Russet, GoldRus and Russet Burbank as a check. This early maturity trial was fertilized with 152

kg/ha of NPK and topkilled 105 days after planting (DAP) with one application of Diquat.

The late maturity trial consisted of A7411-2, Russette, Russet Norkotah, HiLite Russet, BelRus and Russet Burbank as a check. It was fertilized with 185 kg/ha of NPK and let grown 125 DAP at which time several severe morning frosts took care of topkilling.

Both maturity trials were hand planted on May 26, 1989. A split plot randomized block design replicated 4 times was used. Varieties consisted of the main treatment while the three spacings 25,4 cm, 33,0 cm and 40,6 cm represented the split. Single row, 0,91 meters apart and 12,2 meters long were used for each spacing. The three single rows were bordered by guard rows. Hand cut seed weighing 45-50 g, treated with Easout were used for the experiment. Russet Burbank, GoldRus, Russette and BelRus were obtained from New Brunswick Bon Accord Seed Farm. A7411-2, HiLite Russet, Coastal Russet and Centennial Russet were obtained from the Maine Porter Seed Farm. Russet Norkotah seed was acquired from a seed lot produced in New Brunswick in 1988.

Plots were located in Saint André, N.B. on a gravelly clay loam. Both trials were established on a site cropped to peas and sown with winter rye after peas were harvested in 1988. The green winter rye was plowed down a few days prior to planting. Soil analysis taken in the spring of 1989 gave the following results: pH 5.5; % organic matter 2.8; phosphate 513^{+} kg/ha; potash 270 kg/ha, calcium 1050 kg/ha and magnesium 91 kg/ha. On June 14th a mixture of Sencor (.56 kg/ha) and Gramoxone (1 L/ha) was applied at ground crack for grass (volunteer winter rye) and broad leaf weeds control. Cultural practices were similar to those used on commercial farms.

Emergence counts were taken on July 6th. Composite leaf samples were taken on July 24th for mineral analysis.

At harvest, single rows for each spacing were lifted using a one row digger then hand picked into jute bags. Tubers were hand graded into the following categories: undersize - less than 5.1 cm in diameter; stripper - from 5.1 cm in diameter to 227 g in weight; count - 227 g to 454 g; oversize - over 454 g and off-type according to Canada No.1 standards.

Specific gravity was determined using the hydrometer method. Hollow heart ratings indicate the number of hollow tubers observed per 5 tubers in the 284 g to 454 g size category and expressed as a percentage.

Along both trials, observation plots consisting of 5 hills per variety spaced at 33.0 cm and replicated 4 times were established to determine the emergence curve of the varieties. Each replication was pulled out at 70, 82,92 and 100 DAP to assess the varieties bulking rates for marketable and count yield. In addition the number of tubers per plant was determined using those

observation plots. During harvesting and grading, observations on tubers were made and reported herein.

RESULTS

General growth and plant stand

Dry growing conditions occurred in mid-July, with the total precipitation of July 1989 representing only 81% of normal. There were some visible symptoms of plant stress with slower foliage development than normal. However, rainfall was adequate for the remainder of the growing season.

Stand problems were observed in only one variety, Centennial Russet, with only 85% of the target stand (Tables 5 and 6). All the other varieties exceeded 95% of target values. Centennial Russet and Russette emerged relatively slowly (Figures 1 and 2).

Leaf analysis are reported in Tables 1 and 2 . These results suggest more than adequate mineral nutrition. Nitrogen (N) and Phosphorus (P) levels are higher in the late maturing trial than early one, which reflects a higher application rate of N and P. However, higher application of N and P resulted in lower readings of Potash (K), Calcium (Ca) and Magnesium (Mg).

Pest and disease incidence

Adult Colorado Potato Beetles (C.P.B.) were abundant shortly after the crop had emerged. Some of the young potato leaves were chewed by the insects. Insecticide applications were delayed until the appearance of the 3rd and 4th larval stages. Because eggs were hatching for a relatively long period, up to five insecticide applications from two different chemical families (carbarmates and synthetic pyrethroids) were needed in order to control the C.P.B. population.

Early blight lesions on leaves were first observed on August 15 and by September 5, several varieties were severely affected. Russet varieties can be classified according to observed early blight incidence as follows: severe - Russet Norkotah, Centennial Russet, GoldRus, HiLite Russet; moderate -BelRus, Coastal Russet; slight - Russet Burbank, Russette and A7411-2.

Plant description

Observations of plant size, vigour and maturity prior to topkill are reported in Tables 3 and 4.

Stems and tubers per plant

Stems and tubers per plant for each variety are reported in Table 7. Generally, the number of main stems per plant is low. None of the selections had more than two main stems per plant. This is largely due to the use of smaller than desirable seed pieces.

Russet Burbank had the highest set with 15.1 tubers per hill followed by HiLite Russet with 10.5 tubers per hill. All the other selection had from 8.1 to 9.9 tubers per plant.

Tuber bulking rate

Bulking pattern of cultivars for both early and late maturity trials are presented in Figures 3 and 4.

In the early maturity trial Russet Norkotah and HiLite Russet had the earliest bulking pattern of tubers > 113 g. The bulking patterns of those two varieties were similar. The bulking pattern of Coastal Russet was in between the Russet Norkotah/HiLite Russet and Russet Burbank/GoldRus/Centennial. Russet Burbank was the slowest variety to produce > 113 g tubers.

In the late maturity trial, Russet Norkotah and HiLite Russet exhibited the earliest bulking activity. A7411-2 was somewhat intermediate, while Russet Burbank, Russette and BelRus had the latest and slowest bulking pattern.

Early maturity trial

Data for the early maturity trial is reported in Table 5.

Although none of the varieties produced significantly higher total yields than Russet Burbank under the early maturity management regime, marketable yields of Russet Norkotah and HiLite Russet were significantly higher with 131% and 133% of Russet Burbank respectively. Count yields of Russet Norkotah, HiLite and GoldRus were significantly higher than those of Russet Burbank, Centennial Russet and Coastal Russet. Russet Burbank produced significantly more undersize and off type tubers than any of the other cultivars in the trial. HiLite Russet and GoldRus had the highest hollow heart ratings. In addition GoldRus had an average 17% of it tubers covered with scab for more than 10% of their surface.

Coastal Russet had the lowest specific gravity followed by Russet Norkotah/Centennial Russet and HiLite Russet, all significantly lower than Russet Burbank. GoldRus had the highest specific gravity reading.

When all the varieties are combined, as the in-row spacing increased, yields of both undersize and stripper categories significantly decreased. Count yields were significantly higher at both 33.0 cm and 40.6 cm in-row spacing than at 25.4 cm. The oversize yields were significantly higher at 40.6 cm than at either 25.4 cm and 33.0 cm. Although spacing had no significant effect on marketable yields, the total yields were significantly reduced as the spacing increased. Specific gravity was significantly lower at the 40.6 cm spacing than at both 25.4 cm and 33.0 cm.

Variety x spacing interactions were detected for the undersize, stripper, oversize, total and marketable yields. Generally, the

undersize yields increased with a closer in-row spacing. Only HiLite Russet and GoldRus produced significantly higher yields in the stripper category at closer spacings.

Total yields were highest for all varieties with the exception of Russet Burbank at 25.4 cm. The highest total yield for Russet Burbank was produced at 33.0 cm. Marketable yields were not influenced by the in-row spacing with the exception of both Centennial Russet and GoldRus for which the largest spacing produced significantly less marketable yield.

Late maturity trial

Data for the late maturity trial is reported in Table 6.

Again, none of the varieties produced significantly higher total yields than Russet Burbank. However, Russette and Russet Norkotah produced significantly higher marketable yields than Russet Burbank, with 118% and 123% respectively. BelRus had the lowest total and marketable yields of the group.

Russet Norkotah, HiLite Russet, A7411-2 and Russette yielded significantly more tubers in the count categories than Russet Burbank with 175%, 143%, 160% and 141% respectively of the latter. BelRus significantly gave the lowest yield in the count category, Russet Burbank produced the highest yield of undersize. Russette had the highest hollow heart rating. Russet Norkotah and HiLite Russet had the lowest specific gravity of the group.

When all the varieties are combined, as the in-row spacing increased, yields of both undersize and stripper categories significantly decreased. The largest count and oversize yields were obtained at the largest spacing. Both total and marketable yields were unaffected by in-row spacing.

Variety x spacing interactions were detected for undersize, stripper, oversize and off-type yields. Yields of undersize were significantly reduced at the largest spacing with the exception of A7411-2 and Russette.

Stripper yields of Russet Norkotah, HiLite Russet, A7411-2 and Russette increased at the closest spacing. Oversize yields were significantly higher at the largest spacing for both Russet Norkotah and A7411-2. The same thing applied to the off-type yield of A7411-2.

Notes on tubers observation

Russet Norkotah

Average set, uniformly russeted skin, good size, oblong-long tubers. Many well distributed shallow eyes, some scab.

Russet Burbank

Heavy set, very light russeted skin, many smalls, several off-type (knobs), many well distributed shallow eyes.

Coastal Russet

Good set, light russeted skin, mixed size, few eyes.

BelRus

Large set, heavily russeted skin with dark colour, small run, shallow eyes.

HiLite Russet

Average set, good size, pear shaped (pointed toward the stem end), eyes a bit deep and some are surrounded by purple colour in the bud end area, soft skin.

GoldRus

High set, heavily russeted skin, good size of long and uniform tubers, a lot of scab.

Russette

Average set, round tubers, heavily russeted, shallow eyes, clinging to vines.

A7411-2

Good set, long tubers, some off-type, light and irregular russeted skin, mixed sizes, clinging to vines.

CONCLUSION:

This one year study under two maturity management regimes gave the following results.

Early Maturity Trial

Variety	Yield (T/ha)	
	Marketable	Count
HiLite Russet	29.7 a	11.9 a
Russet Norkotah	29.3 a	11.9 a
Coastal Russet	25.1 b	6.2 bc
GoldRus	22.6 bc	8.0 b
Russet Burbank (std)	22.4 bc	4.3 c
Centennial Russet	21.9 c	4.4 c

Late Maturity Trial

Variety	Yield (T/ha)	
	Marketable	Count
Russette	36.6 a	14.3 b
Russet Norkotah	35.1 ab	17.7 a
HiLite Russet	32.9 abc	14.5 ab
A7411-2	31.2 bc	16.2 ab
Russet Burbank (std)	29.7 c	10.1 c
BelRus	24.5 d	4.8 d

In both trials, Russet Burbank was ranked 5th for marketable yield. When comparing the count yield, of all cultivars tested, Russet Burbank came last in the early maturity trial and 5th in the late maturity trial. Only BelRus gave lower yield in the count size than Russet Burbank. Although, these results are for one year only, they point out the yielding capability of some of the promising russeted potato varieties.

Some problems were associated with a few varieties. GoldRus had a severe scab problem. HiLite Russet had several of its tubers pear shaped. A7411-2 had an off shape tuber problem similar to Russet Burbank. Hollow heart rating was significantly higher for Russette than any other cultivars in the late maturity trial. Centennial Russet had a stand problem.

The results from the use of different in-row spacings will be used to develop production management profiles for the most promising russeted potato varieties.

Based on this year and last year data for Russet Norkotah, a preliminary management profile for the production of count carton size potatoes has been drafted and is included in Appendix I .

Further evaluation of the effects of maturity regime management and seed size on yield is required for the completion of Russet Norkotah production management profile.

The development of similar profiles for the other varieties will require the continuity of this program for at least two other years. As new promising russeted varieties are identified, they should be included in the trials.

Table 1. Early maturity trial mid-season leaf analysis

Variety	N	P	K	Ca	Mg	Zn	B	Ca	Mn	Fe
	%					ppm				
Russet Norkotah	6.11	0.44	3.60	0.78	0.44	35	14	21	182	113
Centennial Russet	6.04	0.39	4.10	0.98	0.38	27	22	12	201	122
Coastal Russet	6.08	0.43	4.44	0.99	0.51	27	20	13	244	136
Russet Burbank	5.94	0.42	4.03	0.75	0.39	26	16	19	152	97
GoldRus	5.82	0.38	4.59	0.95	0.45	29	21	14	210	110
HiLite Russet	5.99	0.40	3.94	1.05	0.45	35	22	23	177	121
Average	**6.0**	**0.41**	**4.12**	**0.92**	**0.44**	**30**	**19**	**17**	**194**	**117**

Table 2 Late maturity trial mid-season leaf analysis

Variety	N	P	K	Ca	Mg	Zn	B	Ca	Mn	Fe
	%					ppm				
Russet Burbank	6.27	0.50	3.67	0.63	0.43	40	17	22	165	104
Russet Norkotah	6.42	0.55	4.20	0.72	0.42	37	19	21	178	118
HiLite Russet	6.45	0.45	3.89	0.80	0.35	32	16	21	152	111
BelRus	6.03	0.46	3.74	0.71	0.44	34	24	17	244	136
A7411-2	6.44	0.49	4.05	0.66	0.33	48	18	16	150	115
Russette	6.88	0.62	4.02	0.65	0.40	41	14	19	222	158
Average	**6.42**	**0.51**	**3.92**	**0.70**	**0.40**	**39**	**18**	**19**	**185**	**124**

Table 3. Plant size, vigour and maturity at topkill for the early maturing trial

Variety	Plant [1] Size	Plant [2] Vigour	Plant [3] Maturity
Russet Norkotah	5	4	4
Centennial Russet	5	3	3
Coastal Russet	4	4	3
GoldRus	3	4	3
Russet Burbank	8	6	7
HiLite Russet	4	5	4

Table 4. Plant size, vigour and maturity at topkill for the late maturing

Variety	Plant [1] Site	Plant [2] Vigour	Plant [3] Maturity
Russet Burbank	8	7	8
Russet Norkotah	6	4	4
HiLite Russet	4	3	2
BelRus	4	3	3
A7411-2	7	6	8
Russette	7	8	8.5

1. Plant size: 0 - Small; 10 - large
2. Plant vigour: 0 - very week; 10 - very strong
3. Plant maturity: 0 - very early; 10 very late

TABLE 5. SIZE DISTRIBUTION, % OF STANDARD COUNT YIELD, OFF-TYPE, TOTAL AND MARKETABLE YIELDS, % OF STANDARD MARKETABLE YIELD, EMERGENCE, SPECIFIC GRAVITY, HOLLOW HEART AND SCAB INCIDENCE OF THE EARLY MATURING RUSSETTED POTATO VARIETY GROUP GROWN AT 3 SPACINGS

VARIETY	SPACING (cm)	UNDERSIZE T/HA	STRIPPER T/HA	COUNT T/HA	% OF COUNT STD.	OVERSIZE T/HA	OFF-TYPE T/HA	TOTAL T/HA	MARKETABLE T/HA	% OF MARK. STD.	EMERGENCE	SPECIFIC GRAVITY	HOLLOW HEART	SCAB INCIDENCE
MAIN EFFECT:														
VARIETY														
RUSSET NORKOTAH	AVG	7.3	17.4	11.5	273.7	1.3	0.8	38.7	29.3	131.0	95.9	79.2	8.3	4.5
CENTENNIAL RUSSET	AVG	6.1	17.6	4.4	100.4	0.0	0.3	28.3	21.9	98.0	94.6	79.2	5.0	3.2
COASTAL RUSSET	AVG	8.5	18.9	6.2	143.5	0.2	0.2	33.9	25.1	112.3	96.1	77.6	0.0	4.6
RUSSET BURBANK	AVG	15.4	18.0	4.3	100.0	0.2	2.9	40.9	22.4	100.0	99.2	83.4	3.3	3.4
GOLDRUS	AVG	7.8	14.6	8.0	185.0	0.2	0.6	31.2	22.6	101.0	95.6	87.0	13.3	17.1
HILITE RUSSET	AVG	9.7	17.8	11.9	273.8	0.7	1.2	41.3	29.7	132.7	95.2	81.4	16.7	1.0
LSD DUNCAN(p=0.05)		0.91	2.23	2.02		0.51	0.63	3.32	2.92		2.54	3.2	10.8	
SPACING														
AVG	25.4	11.5	19.1	6.2		0.2	0.7	37.7	25.3		94.8	81.8	8.3	
AVG	33.0	8.8	17.2	8.4		0.2	1.0	35.7	25.6		94.6	82.1	5.0	
AVG	40.6	7.1	15.9	8.7		0.8	1.2	33.6	24.6		95.8	80.0	10.0	
LSD DUNCAN(p=0.05)		0.66	1.31	1.72		0.26	NS	1.49	NS		NS	1.5	NS	
VARIETY X SPACING														
RUSSET NORKOTAH	25.4	9.6	19.5	9.7		0.8	0.9	40.5	29.2		95.4	80.5	5.0	
	33.0	7.4	16.6	11.1		0.6	0.4	36.2	27.5		94.9	79.0	5.0	
	40.6	5.0	16.1	14.8		2.5	1.0	39.5	30.9		97.6	78.0	15.0	
CENTENNIAL RUSSET	25.4	7.2	18.9	3.6		0.0	0.2	29.9	22.4		83.7	81.3	10.0	
	33.0	5.8	17.9	6.0		0.0	0.5	30.2	23.9		86.2	78.8	5.0	
	40.6	5.3	15.9	3.5		0.0	0.1	24.8	19.4		83.9	77.5	0.0	
COASTAL RUSSET	25.4	11.1	20.1	5.8		0.0	0.2	37.1	25.8		95.4	80.0	0.0	
	33.0	8.0	20.0	6.1		0.0	0.0	34.1	26.1		96.1	77.0	0.0	
	40.6	6.5	16.6	6.3		0.5	0.3	30.6	23.4		96.8	75.8	0.0	
RUSSET BURBANK	25.4	19.3	17.6	2.7		0.3	1.8	41.7	20.3		99.5	82.3	5.0	
	33.0	14.7	19.7	4.6		0.2	3.5	42.7	24.3		98.0	85.8	0.0	
	40.6	12.1	16.8	5.7		0.1	3.6	38.3	22.5		100.0	82.3	5.0	
GOLDRUS	25.4	9.2	17.1	8.1		0.1	0.6	35.1	25.2		95.9	85.3	15.0	
	33.0	7.9	13.8	8.1		0.1	0.9	30.8	21.9		96.1	89.5	10.0	
	40.6	6.4	12.8	7.9		0.3	0.3	27.7	20.7		96.8	86.3	15.0	
HILITE RUSSET	25.4	12.7	21.2	7.4		0.1	0.8	42.2	29.6		99.0	81.3	15.0	
	33.0	9.2	15.3	14.6		0.4	1.0	40.5	29.9		98.7	82.5	10.0	
	40.6	7.2	17.0	13.6		1.6	1.6	41.0	30.5		100.0	80.5	25.0	
LSD DUNCAN(p=0.05)		1.61	3.2	NS		0.65	NS	3.64	3.79		NS	NS	NS	

TABLE 6. SIZE DISTRIBUTION, % OF STANDARD COUNT YIELD, OFF-TYPE, TOTAL AND MARKETABLE YIELDS, % OF STANDARD MARKETABLE YIELD, EMERGENCE, SPECIFIC GRAVITY, HOLLOW HEART AND SCAB INCIDENCE OF THE LATE MATURING RUSSETTED POTATO VARIETY GROUP GROWN AT 3 SPACINGS

VARIETY	SPACING (cm)	UNDERSIZE T/HA	STRIPPER T/HA	COUNT T/HA	% OF COUNT STD.	OVERSIZE T/HA	OFF-TYPE T/HA	TOTAL T/HA	MARKETABLE T/HA	% OF MARK. STD	EMERGENCE	SPECIFIC GRAVITY	HOLLOW HEART	SCAB INCIDENCE
MAIN EFFECT:														
VARIETY														
RUSSET BURBANK	AVG	13.8	19.6	10.1	100.0	1.1	6.7	51.3	29.7	100.0	99.8	87.1	6.7	1.0
RUSSET NORKOTAH	AVG	7.3	17.4	17.7	175.3	3.7	1.3	47.4	35.1	118.3	98.1	77.3	3.3	9.6
NELITE RUSSET	AVG	7.4	18.4	14.5	143.3	1.5	1.3	43.1	32.9	110.8	97.7	80.0	1.7	2.0
BELRUS	AVG	8.1	19.7	4.8	47.9	0.0	0.1	32.7	24.5	82.5	96.9	58.6	3.3	1.5
A7411-2	AVG	6.7	15.0	16.2	160.2	4.3	5.1	47.2	31.2	105.0	97.4	86.9	3.3	3.8
RUSSETTE	AVG	4.6	22.3	14.3	141.4	1.1	0.9	43.1	36.6	123.1	97.4	87.3	43.3	1.6
LSD DUNCAN(p=0.05)		1.22	3.23	3.12		1.1	1.08	4.45	4.43		NS	2.79	10.4	
SPACING														
AVG	25.4	9.2	20.6	11.7		1.2	2.3	44.9	32.3		96.9	84.9	10.8	
AVG	33.0	8.2	18.8	13.0		1.9	2.5	44.5	31.8		98.1	84.7	11.7	
AVG	40.6	6.6	16.7	14.1		2.7	2.9	43.1	30.8		99.1	84.0	3.3	
LSD DUNCAN(p=0.05)		0.82	1.31	1.65		0.94	0.59	NS	NS		NS	NS	NS	
VARIETY X SPACING														
RUSSET BURBANK	25.4	15.2	15.1	10.8		0.9	6.4	52.3	29.9		99.5	85.3	5.0	
	33.0	15.5	19.4	8.9		1.2	6.9	52.0	28.4		100.0	88.0	10.0	
	40.6	10.9	20.3	10.6		1.1	6.9	49.7	30.8		100.0	88.0	5.0	
RUSSET NORKOTAH	25.4	8.8	19.9	16.1		2.3	1.2	48.3	36.1		94.4	77.8	10.0	
	33.9	7.1	17.4	18.0		2.7	1.3	46.6	35.4		98.7	78.5	0.0	
	40.6	6.0	14.9	19.0		6.0	1.3	47.3	33.9		97.6	75.5	0.0	
NELITE RUSSET	25.4	9.1	21.5	10.3		0.3	1.3	43.6	32.4		95.9	80.0	0.0	
	33.0	7.4	18.7	16.3		1.6	1.2	45.2	35.0		98.7	79.5	5.0	
	40.6	5.6	15.1	16.1		2.2	1.5	40.6	31.2		99.2	80.5	0.0	
BELRUS	25.4	9.2	21.1	3.9		0.0	0.1	34.3	25.0		98.5	89.5	0.0	
	33.0	8.7	19.8	4.3		0.0	0.0	32.7	24.1		98.0	87.5	5.0	
	40.6	6.4	18.2	6.3		0.0	0.1	31.0	24.5		98.4	88.8	5.0	
A7411-2	25.4	8.2	17.1	15.4		2.2	3.8	46.7	32.5		97.0	89.0	0.0	
	33.0	5.7	15.9	16.5		4.2	4.6	46.9	32.4		98.0	86.8	10.0	
	40.6	6.2	11.9	16.7		6.4	6.9	48.1	28.6		99.2	85.0	0.0	
RUSSETTE	25.4	4.8	25.0	12.9		0.7	0.8	44.2	38.0		96.4	87.8	50.0	
	33.0	4.7	21.7	14.0		1.9	1.2	43.5	35.7		95.4	87.8	40.0	
	40.6	4.3	20.1	15.9		0.6	0.9	41.7	36.0		100.0	86.5	40.0	
LSD DUNCAN(p=0.05)		2.02	3.2	NS		2.29	1.45	NS	NS		NS	NS	NS	

Table 7. Average number of stems and tubers per plant. Grand Falls location, 1989 data.

VARIETY	STEMS/PLANTS	TUBERS/PLANT
A7411-2	1.77	8.1
BelRus	1.74	8.3
Centennial Russet	1.85	8.2
Coastal Russet	1.82	8.5
Goldrus	1.88	9.9
HiLite Russet	1.66	10.5
Russette	1.42	9.8
Russet Burbank	1.85	15.1
Russet Norkotah	1.73	9.1
Average	1.64	9.7

FIGURE 1 EMERGENCE CURVES EARLY MATURING TRIAL

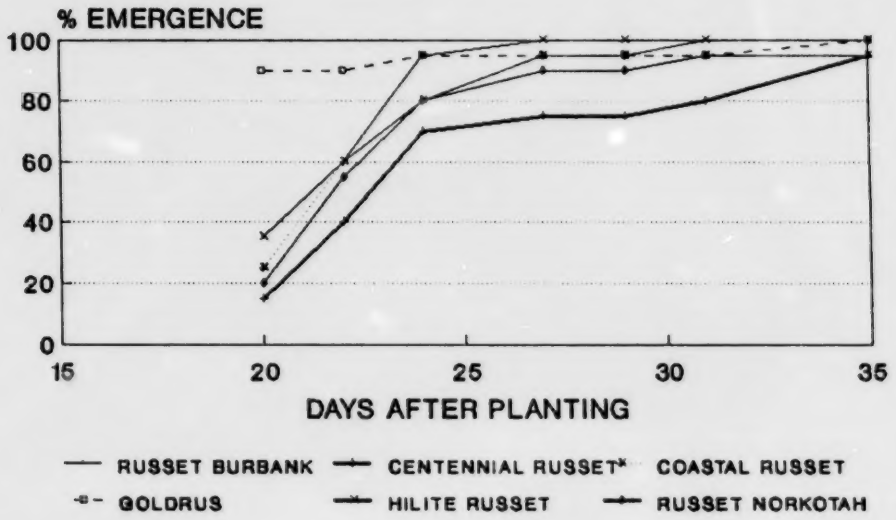


FIGURE 2 EMERGENCE CURVES LATE MATURING TRIAL

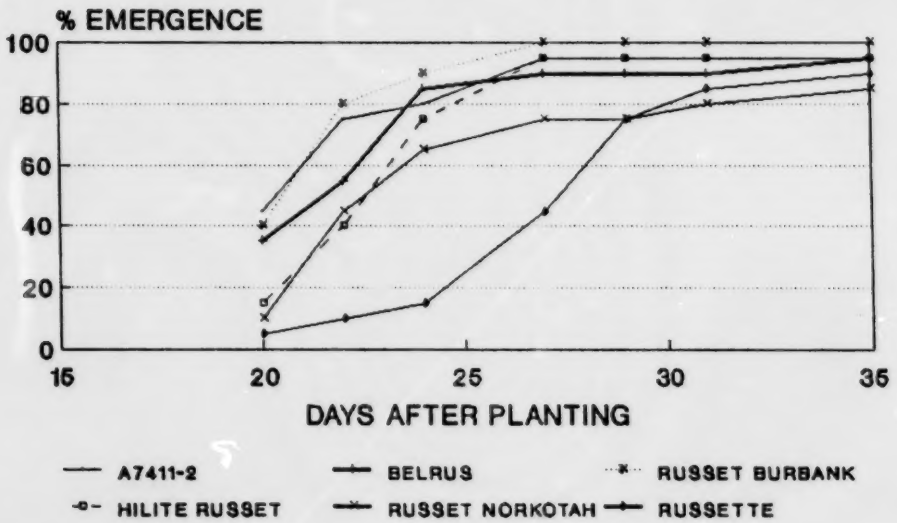


FIGURE 3 EARLY MATURITY TRIAL BULKING RATE ABOVE 113 g YIELD

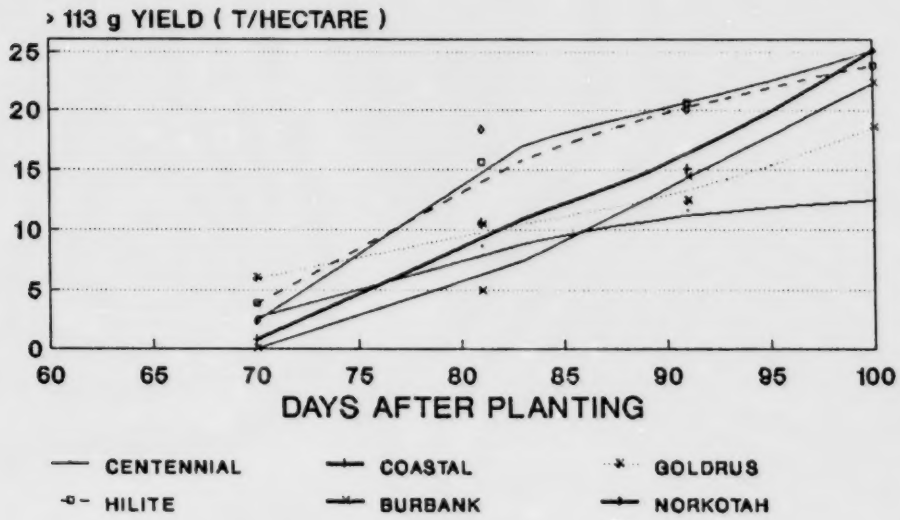
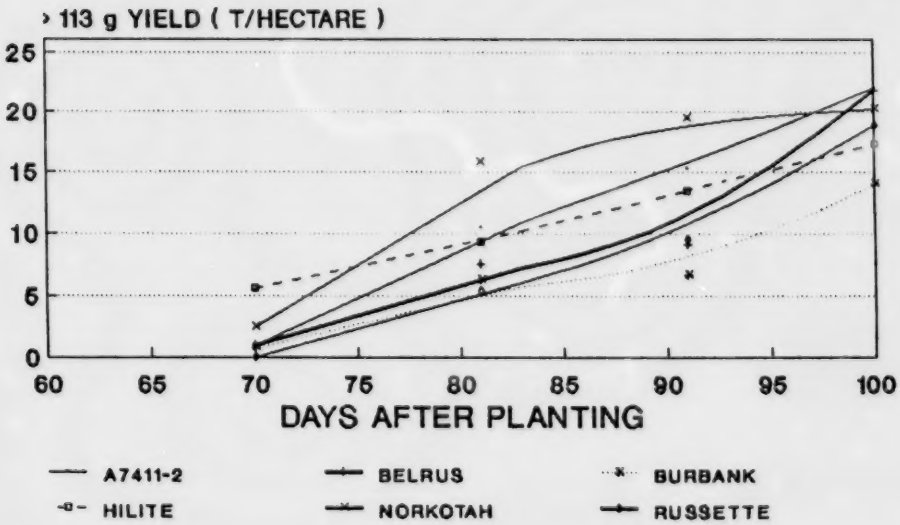


FIGURE 4 LATE MATURIETY TRIAL BULKING RATE ABOVE 113 g YIELD



APPENDIX 1

RUSSET NORKOTAH

A PRELIMINARY MANAGEMENT PROFILE FOR THE PRODUCTION OF COUNT CARTON SIZE POTATOES

BY

GHISLAIN J. PELLETIER

INTRODUCTION

Russet Norkotah is a recently released potato cultivar. It has received a lot of publicity in potato medias. As a result, there is a great interest from growers in this variety for the count carton trade. As this interest translates into action, potato growers are seeking agronomic and production information for this variety.

This preliminary Russet Norkotah Management Profile for count carton production is intended to provide the N.B. potato industry with some preliminary information on the "grow how" of the variety. The recommendations herein are based on two years of trials and on a one year evaluation of some eleven commercial potato fields, all conducted in the Grand Falls area.

DESCRIPTION

Russet Norkotah is a selection from a cross of ND9526-4 RUSS x ND9687-5 RUSS by the North Dakotah State University and was released in 1987. It was previously tested as ND544-4 RUSS.

Plants are of medium size with a slightly upright growth and with white flowers. Tubers are long and smooth with fairly numerous and well distributed eyes. Tubers are of a golden russet skin and the flesh is white.

Russet Norkotah produces a high percentage of marketable potatoes in the count carton size. Total solids, as measured by specific gravity, are considered to be a limiting factor for the production of french fries. Russet Norkotah has been found to be excellent for boiling and baking and shows very little after-cooking darkening.

Russet Norkotah is susceptible to most viruses and also to both early and late blight. Although this cultivar is susceptible to PVY, it will carry this virus without expressing symptoms. Russet Norkotah is also susceptible to verticillium wilt.

MATURITY

Russet Norkotah is classified as early to medium maturity. In New Brunswick trials (1989 Grand Falls Data), this cultivar was considerably earlier that Russet Burbank and earlier than BelRus for the production of > 4 oz tubers. This was even more evident for the production of > 8 oz tubers. (Figures 1 and 2).

YIELD

Although the Russet Norkotah total yield (Table 1) was lower than for Russet Burbank, the marketable yield (Table 2) was consistently higher than that of Russet Burbank. On a two year average with all management levels combined, Russet Norkotah yielded 21 barrels/acre more than Russet Burbank which represents an increase of 15%. The difference in yield in the count carton size (Table 5) is even more important. Russet Norkotah yielded an average 36 barrels/acre of potatoes in the count carton size more than Russet Burbank, representing an increase of 52%. The count carton size represented more than half (52%) of Russet Norkotah total yield; while it only represented less than one third (31%) of Russet Burbank total yield.

Stem and tuber counts are given in Table 4 for growers to compare with their own counts. Seed pieces used in these experiments weighed an average 1 3/4 oz.

PRODUCTION RECOMMENDATIONS

Seed

No special problems have been encountered with this variety. Tubers are long with fairly numerous and well distributed eyes over the surface. As with all varieties, tubers should be sized properly before cutting. Russet Norkotah has a tendency to produce large tubers (over 12 oz.). These over size tubers should be avoided for seed. Because of the number of eyes and their distribution on the tubers, seed pieces size can be cut similar to size of what is recommended for Russet Burbank with an average of 1 3/4 oz., without creating a blind seed problem.

The susceptibility of Russet Norkotah to seed piece decay is not well known. The use of a seed piece treatment is recommended.

Planting

The use of a 10 inches spacing for cut seed has given the highest marketable yield for Russet Norkotah. However, count yield is increased with a larger spacing. If the aim is to produce count carton size potatoes, then the use of a 12-13 inch spacing is advisable. Such a spacing will increase the count production with a slight decrease on the marketable yield. The use of spacing greater than 13 inches will result in a further reduction of

marketable yield and in an increase of oversize potatoes (> 16 oz).

Fertilizer rate

Russet Norkotah did not respond to fertilizer rates higher than 120-135 lb/acre of Nitrogen. Rates of 800 to 900 lb/acre of 15-15-15 or the equivalent in nitrogen with adjustment made for P and K soil analysis is recommended. Lower N rates could be used after a clover crop.

Weed control

With its small foliage and root system, Russet Norkotah does not compete very well with weeds. Therefore, a good weed control program is necessary. Russet Norkotah has not shown any sensitivity to lower rates of Metribuzin applications.

Cultivation and hilling

Cultivation and hilling under dry soil conditions should be avoided as they dry the soil even more and stress the potato plant unduly. Some commercial fields have produced some amount of sunburned potatoes. The making of a large hill after the initiation of the tubers is likely to solve this problem.

Disease control

Russet Norkotah is susceptible to both late and early blight. A good fungicide spray program is necessary to protect this cultivar. Russet Norkotah is also susceptible to verticillium wilt, which results in the premature death of the potato plant (early dying) and consequently in a reduced yield. For this reason, fields with a verticillium wilt history or with a poor rotation program should be avoided. Fields with drainage problems should not be used to grow this variety as they will produce water-soaked tubers.

Because this variety can harbor PVY without expressing any symptoms the fields used to grow Russet Norkotah should be isolated from seed fields.

Topkilling

No special problems have been encountered with topkilling. Delaying topkill until 110-115 days after planting has given the best results.

Harvest handling

Russet Norkotah, with its well set skin didn't bruise easily. Harvest should be conducted when tubers are fully mature and skin is properly set.

FIGURE 1 SELECTED RUSSET VARIETES ABOVE 4 oz BULKING RATE

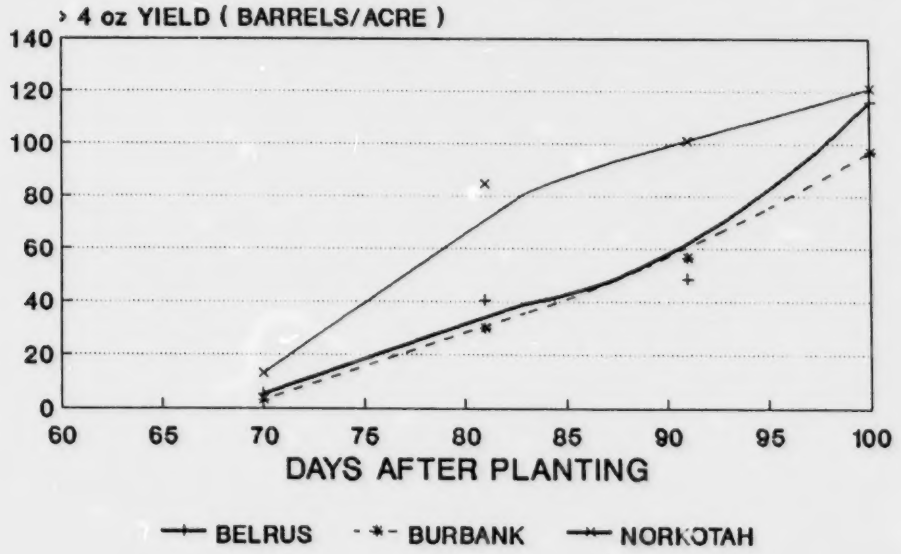


FIGURE 2 SELECTED RUSSET VARIETES ABOVE 8 oz BULKING RATE

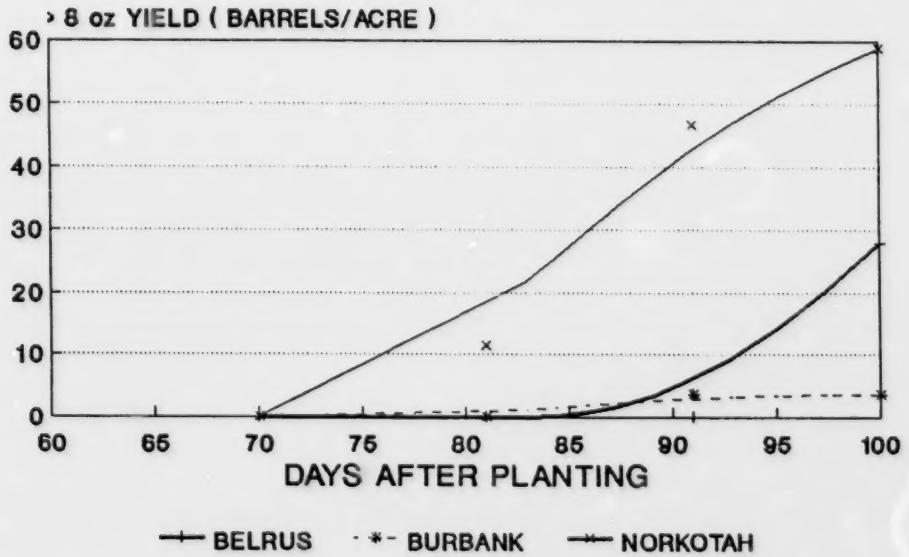


Table 1. Grand Falls location two year data on total yields of Russet Norkotah and Russet Burbank and Russet Norkotah total yield expressed as % of Russet Burbank under different levels of management.

	TOTAL YIELD (BARRELS/ACRE)							
	1988 Fertilizer rate (lbs/acre) of 15-15-15				1989 Maturity Management[1]			Avg 88/89
Spacing	800	1000	1200	Avg	Early	Late	Avg	
	RN/RB/%RB[2]	RN/RB/%RB	RN/RB/%RB	RN/RB/%RB	RN/RB/%RB	RN/RB/%RB	RN/RB/%RB	RN/RB/%RB
10	178/189/94	178/191/93	191/207/92	182/196/93	219/225/97	261/283/92	240/254/95	211/225/94
13	180/192/94	170/193/88	178/196/91	176/193/92	196/231/85	252/281/90	224/256/88	200/225/89
16	168/191/88	155/180/86	173/200/87	165/190/87	214/207/103	256/269/95	235/238/99	200/214/94
AVG	175/191/92	168/188/89	180/201/90	175/193/91	209/222/94	256/278/92	233/250/93	204/222/92

1: Maturity management
Early: 135 lb/ac of NPK, topkilled 105 days after planting
Late: 165 lb/ac of NPK, topkilled 125 days after planting

2: RN: Russet Norkotah
RB: Russet Burbank
%RB: Russet Norkotah expressed as a % of Russet Burbank

Table 2. Grand Falls location two year data on marketable yield of Russet Norkotah and Russet Burbank and Russet Norkotah marketable yield expressed as % of Russet Burbank under different levels of management.

	MARKETABLE YIELD (BARRELS/ACRE)							
	1988 Fertilizer rate (lbs/acre) of 15-15-15				1989 Maturity Management[1]			Avg 88/89
Spacing	800	1000	1200	Avg	Early	Late	Avg	
	RN/RB/%RB[2]	RN/RB/%RB	RN/RB/%RB	RN/RB/%RB	RN/RB/%RB	RN/RB/%RB	RN/RB/%RB	RN/RB/%RB
10	151/140/108	155/145/107	167/149/112	158/144/110	158/110/144	195/162/120	177/136/130	168/140/120
13	159/145/110	148/142/104	160/147/109	156/145/108	150/131/115	192/153/125	171/142/120	164/144/114
16	151/150/101	137/132/104	154/146/106	147/143/103	167/122/137	183/167/110	175/145/121	161/144/112
AVG	154/145/106	147/139/106	160/147/109	154/144/107	158/121/131	190/161/118	174/141/123	164/143/115

1: Maturity management
Early: 135 lb/ac of NPK, topkilled 105 days after planting
Late: 165 lb/ac of NPK, topkilled 125 days after planting

2: RN: Russet Norkotah
RB: Russet Burbank
%RB: Russet Norkotah expressed as a % of Russet Burbank

Table 3. Grand Falls location two year data on count yields of Russet Norkotah and Russet Burbank and Russet Norkotah count yield expressed as % of Russet Burbank under different levels of management.

COUNT YIELD[1] (BARRELS/ACRE)

	1988 Fertilizer rate (lbs/acre)				1989 Maturity Management[2]			Avg 89/90
Spacing	800	1000	1200	Avg	Early	Late	Avg	
	RN/RB/%RB[3]	RN/RB/%RB	RN/RB/%RB	RN/RB/%RB	RN/RB/%RB	RN/RB/%RB	RN/RB/%RB	RN/RB/%RB
10	121/84/144	125/98/128	134/88/152	126/90/140	52/15/347	87/58/150	70/37/189	98/64/153
13	132/98/135	128/100/128	135/102/132	132/100/132	60/25/240	97/48/202	79/37/214	106/69/154
16	132/105/126	120/97/124	133/107/124	128/103/124	80/31/258	103/57/181	92/44/209	110/74/149
AVG	129/96/134	124/99/125	134/99/135	129/98/132	64/24/267	96/55/175	80/40/200	105/69/152

1. Count yield: In 1988 a roller sizer was used to separate the count yield; as a result smallest tuber in the count categories weight 6-7 ounces. In 1989, individual tuber were hand weight and count yield were those in the 8 - 16 ounces categories.

2. Maturity management: Early: 135 lb of NPK, topkilled 105 days after planting
Late: 165 lb of NPK, topkilled 125 days after planting

3. RN: Russet Norkotah
RB: Russet Burbank
%RB: Russet Norkotah expressed as a % of Russet Burbank

Table 4. Average number of stems and tubers per plant. Grand Falls location, 1989 data.

VARIETY	STEMS/PLANTS	TUBERS/PLANT
A7411-2	1.77	8.1
BelRus	1.74	8.3
Centennial Russet	1.85	8.2
Coastal Russet	1.82	8.5
Goldrus	1.88	9.9
HiLite Russet	1.66	10.5
Russette	1.42	9.8
Russet Burbank	1.85	15.1
Russet Norkotah	1.73	9.1
Average	1.64	9.7

ETUDE DE L'EFFET DE L'ESPACEMENT ET DE LA NON-UNIFORMITE DU PLACEMENT DE LA SEMENCE SHEPODY

Ghislain J. Pelletier

Résumé: Des planteuses de pommes de terre au Nouveau-Brunswick donnent des coefficients de variation (CV) variant de 30 à 87%. Bien que beaucoup d'efforts aient été consacrés pour déterminer l'espacement idéal des plants de Shepody destinés à la qualité du placement des semences.

Des essais en 1988 et 1989 ont été entrepris afin de quantifier l'effet de la variation dans le placement des plants sur la récolte de Shepody en utilisant les trois espacements de 25.4, 30.5 et 35.6 cm avec 4 CV de 0, 25, 50 et 75%.

Lorsque le CV passe de 0% à 75%, on a observé une réduction significative du rendement vendable de 10%. Cette réduction de rendement est d'environ 6% lorsque le CV passe de 50% à 75%.

THE EFFECT OF SEED SPACING AND IRREGULAR IN-ROW SPACING ON SHEPODY YIELD

Abstract: Commercial potato planters used in New Brunswick will give coefficient of variation (COV) ranging from 30 to 87%.

A lot of work has been devoted to determine the best seed spacing for Shepody grown for processing. However, little work has been done on the effect of the irregularity of seed spacing on Shepody.

In order to assess the effect of irregular spacing on Shepody yields, split-plot trials were established in 1988 and 1989 with the main factor being the three spacings (25.4, 30.5 and 35.6 cm) and the split being four levels of COV 0%, 25%, 50% and 75%.

The increase of COV level from 0% to 75% resulted in a significant reduction of the marketable yield by 10%. Marketable yield reduction of 6% was associated with an increase of COV level from 50% to 75%.

INTRODUCTION: Des enquêtes effectuées sur la levée des plants dans les champs de pommes de terre ont revélé des variations importantes dans le placement des semences. Non seulement la quantité de plantes par unité de surface est t'elle inférieure à celle désirée, mais les plantes sont placées sur le rang à des intervalles irréguliers.

Plusieurs années d'études sur l'espacement des plants de Shepody ont été réalisées, et dans le dernier profil cultural publié par le Dr. Ken Rykbost en 1987, la recommandation pour l'espacement

des plants de Shepody destinés à la transformation est de 25.4 à 27.9 cm.

Toutefois, peu ou pas d'attention a été donnée à l'effet de l'uniformité du placement des plants. Les enquêtes effectuées révèlent que pour les planteuses commerciales utilisées au Nouveau-Brunswick le coefficient de variation (mesure relative de l'écart-type sur la moyenne) obtenu varie de 30 à 87% selon la planteuse utilisée, le type et l'uniformité de la semence, de même que la vitesse d'opération.

Cette étude a été entreprise afin de quantifier l'effet de la variation dans le placement des plants sur la récolte de Shepody.

MATÉRIEL ET MÉTHODE: Des essais ont été établis à Grand-Sault en 1988 et 1989. Un dispositif expérimental de split plot à quatre répétitions a été utilisé. Les trois espacements sur le rang de 25.4, 30.5 et 35.6 cm ont constitué le traitement principal, alors que les quatre CV de 0%, 25%, 50% et 75% ont constitué le sous-traitement. Chaque sous-parcelle comprenait un rang de 10.1 mètre de longueur. Des semences tranchées de Shepody ont été utilisées dans cette étude.

Le classage des échantillons a été effectué comme suit: petites - diamètre inférieures à 5.1 cm; moyennes - de 5.1 cm à 284 g; grosses - plus de 284 g. La catégorie vendable comprend la somme des catégories moyennes et petites.

RÉSULTATS: Les résultats de l'essai sont présentés au tableau 1. Pour les deux années confondues, les rendements total et vendable sont significativement plus élevés lorsque le CV passe de 75% à 0%. Ainsi, le rendement vendable du niveau de CV de 0% est de 10% supérieur à celui du niveau de CV de 75%. Bien que non significatives, les augmentations de rendement vendable pour le CV de 0% sont de 1,0% et 3,0% supérieures aux niveaux de CV de 25% et 50% respectivement. Des ordres de grandeur semblables s'appliquent au rendement total. Cette réduction des rendements s'explique par une baisse de rendement des tubercules de la catégorie grosses.

L'utilisation de différents espacements n'a pas donné de différence significative pour les rendements total et vendable. Cependant on remarque un accroissement significatif des rendements des catégories moyennes et petites lorsque l'espacement passe de 35.6 cm ou 30.5 cm.

Aucune interaction entre l'espacement des plants et le niveau de CV n'a été décelée en ce qui concerne les rendements total et vendable.

CONCLUSION: L'irrégularité dans le placement des semences pour les niveaux de CV variant de 0% à 75% est accompagnée d'une réduction du rendement vendable de l'ordre de 10%. Lorsque le niveau de CV passe de 50% à 75%, la réduction du rendement vendable est de 6% pour la variété Shepody.

Ces essais de deux années viennent confirmer que les producteurs de pommes de terre auraient intérêt à reviser leurs opérations de tranchage des semences et de plantation afin de s'assurer d'une plantation aussi uniforme que possible.

TABLEAU 4: EFFET DE L'ESPACEMENT ET DE LA VARIATION DANS LE PLACEMENT DES PLANTS SUR LA RÉCOLTE DE SHEPODY POUR LES SAISONS 1988 ET 1989

	RENDEMENT (t/ha)														
EFFETS PRINCIPAUX	PETITES			MOYENNES			GROSSES			TOTAL			VENDABLES		
Espacement (cm)	1988	1989	Moy.	1988	1989	Moy.	1988	1989	Moy.	1988	1989	Moy.	1988	1989	Moy.
25.4	4.0	3.4^{ab}	3.7^{a}	16.3	21.7^{a}	19.0^{a}	13.9	12.9	13.4	34.5	37.9	36.0	30.2	34.5	32.3
30.5	3.7	3.9^{a}	3.8^{a}	16.8	20.9^{ab}	18.9^{a}	14.3	13.5	13.9	35.5	38.3	36.6	31.1	34.5	32.8
35.6	3.5	3.0^{b}	3.2^{b}	16.0	18.8^{b}	17.4^{b}	14.4	14.3	14.3	34.5	36.1	35.0	30.3	33.1	31.7
CV (%)															
0	3.5	3.2	3.3^{b}	16.6	20.4	18.5	15.8	13.8	14.8^{a}	36.5^{a}	37.5	36.7^{a}	32.5^{a}	34.3	33.3^{a}
25	3.9	3.4	3.7^{ab}	16.0	20.8	18.4	14.5	14.8	14.7^{a}	35.0^{ab}	39.1	36.7^{a}	30.5^{ab}	35.7	33.1^{a}
50	3.8	3.7	3.7^{a}	16.9	21.1	19.0	13.7	12.9	12.9^{b}	35.0^{ab}	37.7	36.1^{a}	30.7^{ab}	34.0	32.3^{ab}
75	3.8	3.2	3.5^{ab}	15.8	19.5	17.6	12.7	12.6	12.7^{b}	32.5^{b}	35.5	33.9^{b}	28.5^{b}	32.1	30.4^{b}

Les moyennes d'une même colonne dont les lettres diffèrent sont significatives à p = 0.1 (Duncan)

OBSERVATIONS ON THE USE OF A INTER-ROW ROTARY CULTIVATOR IN POTATO PRODUCTION

Ghislain J. Pelletier

SUMMARY

The use of a inter-row rotary cultivator in potato production was investigated with the Shepody variety in a sandy loam. The inter-row rotary cultivator was used at 70% crop emergence stage. Emergence was delayed by approximately 5 days. However, there was no difference in the final plant stand between the inter-row rotary cultivator and the conventional hilling. Weed control was poor under the inter-row rotary cultivator. Although not significant, marketable yield under the inter-row cultivator were 5% lower than for the conventional hilling. The amount of small and sunburned potatoes was higher in the rotary cultivator treatment than in the check. The incidence of hollow heart was reduced by the rotary hiller and so was the specific gravity.

RESUME

L'utilisation d'une butteuse à crochets dans la production de la pomme de terre a été évalué avec la variété de pomme de terre Shepody dans un loam sableux. La butteuse à crochets a été utilisée au stade 70% émergence de la culture.

L'émergence a été retardé d'environ 5 jours. Cependant, il n'y a eu aucune différence dans la population finale des plants entre les deux traitements. La repression des mauvaises herbes avec l'utilisation de la butteuse à crochets a été pauvre. Bien que non significatif, le rendement de la catégorie vendable a été de 5% inférieur pour le traitement butteuse à crochet comparativement à la butteuse conventionnelle.

La quantité de pommes de terre petites et verdies a été plus élevée avec la butteuse à crochets. L'incidence du coeur creux de même que le poids spécifique ont été réduit avec l'utilisation de la butteuse à crochet.

INTRODUCTION

In potato production in New Brunswick, the making of a hill for the development and the growth of the tubers is usually carried out in two to three field operations. Firstly, there is the cultivation operation which is done with a tool bar mounted on the tractor. On this tool bar, tines are attached in a way that the soil in the furrow is loosen up. This operation is carried out two to three weeks after the crop had emerged. The main purpose of this activity is to loosen the soil before the hilling takes place. However, this preliminary operation is sometimes omitted by some potato producers. The hilling operation is carried out with

spades and sometimes disks preceded by tines. Usually it is a one time operation, although some producers will do it up to three times. Generally, the last hilling takes place when the tubers have reached 1 1/2 - 2 cm in diameter.

Lately, a new type of hiller has caught the interest of some producers: the inter-row rotary cultivator. The implement was developed in Europe and had been use with success on heavy soils. The rotor tines are activated by the tractor's P.T.O. and operate in the furrow immediately in front of the hill shaper which give an intensive crumbled tilt in a large, firm, convex and identical hills. This is contrary to spade or disk hillers which brings clods detached by the proceeding tines in a much looser and heaped hill. The inter-row rotary cultivator is used only one time in the season prior to crop emergence. Weed control is usually achieved by applying a soil acting herbicide after the hilling.

Easier and faster harvesting (clod free hills), reduction of green potatoes (large convex hills) and easier vine pulling (identical and uniform hills) are some of the advantages reported with the use of inter-row rotary cultivator in Europe.

With the assistance of the New Brunswick Canada Agri-Food Technology Demonstration Program, Linton Enterprises Ltd of Arthurette purchased a Rumpstad Hooktine cultivator. This implement was used in the spring of 1989 on both Russet Burbank and Shepody. For the purpose of evaluation, a Shepody field was chosen and monitored through the season.

MATERIAL AND METHOD

A four row Rumpstad Hooktine cultivator was used for this demonstration. A 10 acre field of a stone free sandy loam with the following cropping history - Grain/hay/hay/potatoes - was chosen to establish two 40 row strips. One strip was hilled with the conventional means, the other was hilled using a Rumpstad Hooktine cultivator. The initial plans were to establish 3 strips: (1) conventional, (2) Rumpstad shortly after planting and (3) Rumpstad at ground crack.

The uncontrollable delay in getting the equipment ready for the field had forced the abandon of the proposed crop stages with the Rumpstad. Instead, only one Rumpstad treatment was retained for the evaluation: as soon as the equipment could be used in the field. This corresponded to 70 - 80% crop emergence. For the purpose of the evaluation, foundation class Shepody cut seed was planted on May 20th at an intended spacing of 10 inches. The crop was fertilized with 1150 lb/acre of 10-10-10 1% Mg. Soil test analysis taken close to planting revealed the following results.

Components	Rumpstad	Conventional
% Organic matter	2.0	2.0
pH	6.3	6.1
P^2O^5	513 +	513 +
K^2O	384	430 +
Ca	1554	2132
Mg	408	448 +

The hilling programs were as followed: Rumpstad - 70% crop emergence (June 20th); Conventional - cultivation on June 21st followed by two hilling operation (June 29th and July 7th).

Lorox at the recommended rate was applied after the Rumpstad operation on the same day. Since the crop was already at the 70% emergence stage, no herbicide was applied on the conventional strip.

In each strips, 6 randomly selected 50 foot sections were used to assess the crop emergence curve and final plant stand (July 7th), the crop nutritional status by collecting leave samples (July 14th) and the weed population (August 2nd).

The first topkiller application was made on September 5th. Potato samples were collected from 10 x 10 foot sections per strip on September 22nd for yield and quality determination. Potatoes were hand graded into the following categories: smalls - less than 2 inches in diameter; medium size - from 2 inches in diameter to 8 oz in weight; large - from 8 oz to 16 oz in weight and oversize - above 16 oz in weight. In addition the amount of sunburned potatoes and hollow heart (number of hollow tubers or 10 large tubers) was assessed. Specific gravity was determined using the hydrometer method.

RESULTS

Emergence and plant stand

Emergence curves for both treatment are presented in Figure 1. The Rumpstad treatment covered all the plants that were up at that time (65-70%). It took some 5 days for the plants in the Rumpstad treatment to catch up with those of the conventional treatment.

The plant stand data is presented in Table 1. No difference from treatments were observed on the final plant population. However, the final plant population was only 68% of that intended.

Although the plant population for both treatments did not differ, visual difference were detectable. Plants in the Rumpstad treatment were for some times smaller and looked paler than those of the conventional treatment as if they were on some sort of stress.

Crop nutritional status

Results from the leaves analyses are presented in Table 2. For both treatments the results indicate more than adequate mineral nutrition with no significant difference between treatments.

Weed count

Results from the weed count taken on August 2nd are presented in Table 3. A higher weed population particularly the barnyard grass was present in the Rumpstad treatment than in the conventional. Two explanations are advance for this situation. Firstly, following the herbicide application in the Rumpstad treatment, less than 3/4 inch of rain felt down in a period of 3 weeks. This low amount of moisture was detrimental to the action of the product applied. Secondly, once the Rumpstad treatment had been carried out, the strip received no further cultivations contrary to the conventional treatment for which up to 3 cultivation/hilling operations were carried out until the first week of July at which time the crop canopy was well established and offered good competition to weed seedlings.

Yield and quality

Yield and quality results are presented in Table 4 and 5.

Although not significantly different, yield of total, marketable, above 16 oz and 8 oz to 16 oz categories were slightly higher for the conventional treatment that the Rumpstad treatment. However, yield of the small (less than 2 inches in diameter) was significantly higher for the Rumpstad than for the conventional.

The following quality parameters were assessed: % smalls, % sunburn, % hollow heart and specific gravity.

Percentages of smalls and sunburned were the highest for the Rumpstad treatment. The shorter available period for photosynthesis and the stress imposed upon the emerged plants with the Rumpstad implement are likely to be responsible for this situation. The significant increased in the amount of sunburned potatoes is in contradiction with other reports. The occurrence of such greater amount of sunburned potatoes was observed under two conditions. Firstly the equal spaced hills (36") made by the Rumpstad did not exactly match the rows of the planter used in that field. As a result, several plants were not centred on the hill, instead they were growing on the side of the hill and some tubers were exposed to light. Secondly at harvest, several soil cracks were apparent on the top of the hills. From some of these cracks measuring from 3/4 to 1 inch large, tubers of the plant, some 4 to 5 inches below the top, were visible.

A significant reduction of hollow heart in the large tubers were observed with the Rumpstad treatment.

Specific gravity readings were .004 lower for the Rumpstad treatment than for the conventional. Again, the relativity short growing season available to the plants under the Rumpstad treatment could have played a role in retarding the crop maturity.

Table 1. Effect of hilling treatments on the plant stand.

Treatment	Desired Spacings Inches	Obtained Spacings Inches	% plant Stand	Stem per Plant
Rumpstad	10.0	14.7	68%	2.5
Conventional	10.0	14.7	68%	2.3

Table 2. Effect of hilling treatments on plant mineral nutritional status

	%					ppm				
Treatment	N	P	K	Ca	Mg	Zn	B	Cu	Mn	Fe
Rumpstad	6.4	0.57	3.72	0.63	0.49	31	18	12	100	124
Conventional	6.4	0.63	3.65	0.54	0.48	39	19	12	107	111

Table 3. Effect of hilling treatments on the weed population

	Weed/ square yard				
Treatment	Lamb's quarters	Barnyard grass	Wild mustard	Lady's thumb	Total
Rumpstad	.03	1.8	0.02	.02	1.9
Conventional	.03	0.07	0	0	0.1

Table 4. Effect of Rumpstad Hooktine cultivars on yield of Shepody crop

	Yield (Barrels/acre)					
Treatment	< 2"	2"-8oz	8 oz-16 oz	>16 oz	Total	Marketable
Rumpstad	16.4	89.4	77.9	10.4	194.2	177.8
33Conventional	11.7	84.4	89.4	13.4	198.5	186.9
Significant at p= 0.05	Yes	No	No	No	No	No

Table 5. Effect of Rumpstad Hooktine cultivar on the quality of Shepody crop

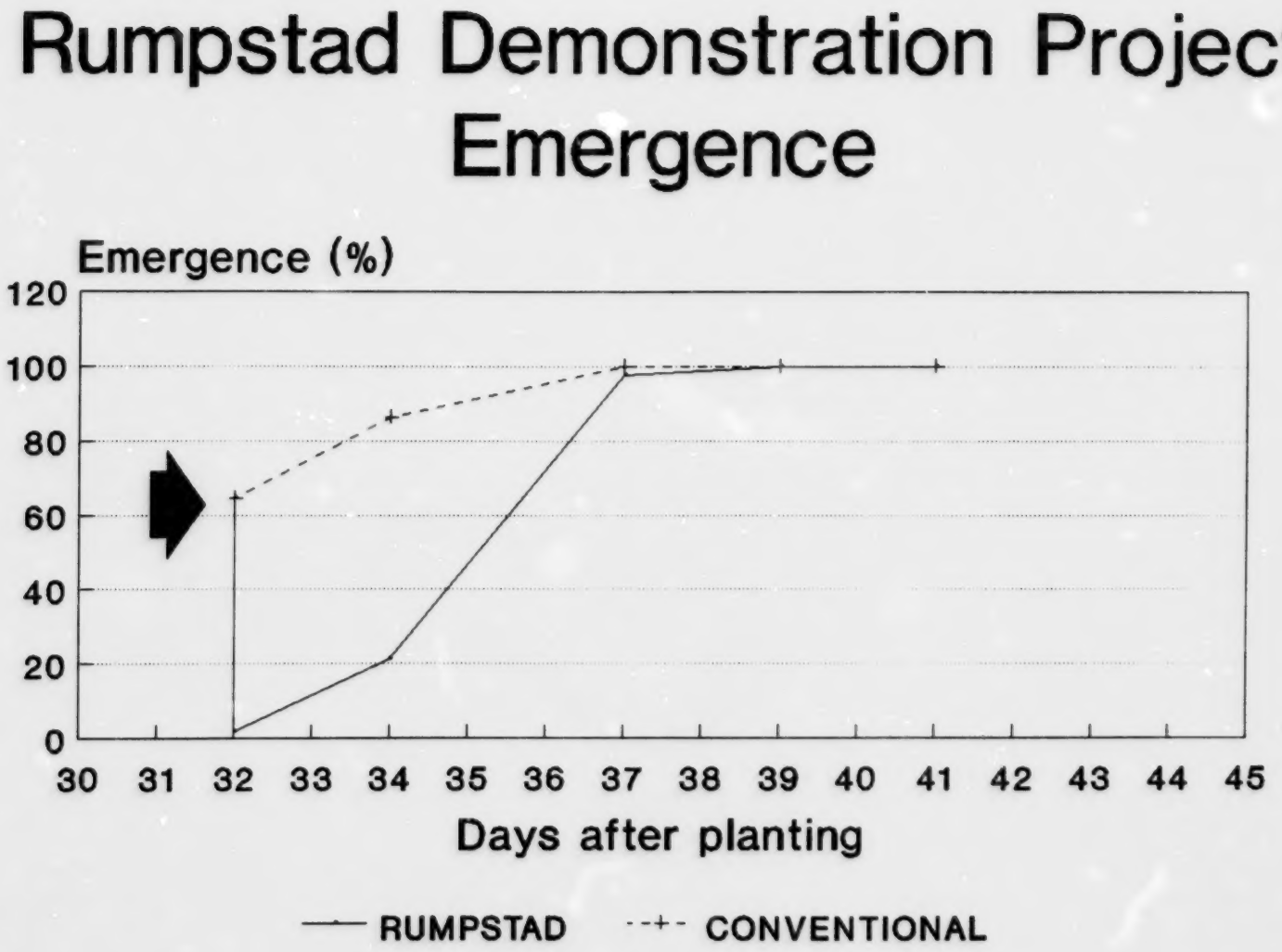
	%			Specific
Treatment	Smalls	Sunburn	Hollow heart	Gravity
Rumpstad	8.4	8.0	8	1.078
Conventional	5.9	5.1	21	1.082
Significant at p= 0.05	Yes	Yes	Yes	Yes

CONCLUSION

Although this represents only one year of data and that the timing of the operation was perhaps too late in relation to the potato crop stage, some of the observation made in relation to the delay in emergence the greater amount of small potatoes, the reduction in the specific gravity and the weed problems encountered should be a concern with the use of the inter-row rotary cultivator.

It is suggested that further evaluation on the timing of the operation, and the weed control be conducted before drawing any final conclusion.

Figure 1: Emergence curve



A Preliminary Evaluation of the Use of Erosion Control Mats for Grassed Waterway Construction in New Brunswick.

Clair Gartley, P. Eng.; J. L. Daigle, P. Eng.;
Walter Allison, P. Eng.

ABSTRACT: To determine an appropriate method for improving grassed waterway construction techniques, three types of erosion mats were applied to six waterways. 'Curlex lo-velocity blanket' was applied to one small waterway constructed in 1988 and to the eroded top and centre of two large waterways constructed in 1987. 'Curlex hi-velocity blanket' was applied to two large waterways constructed in 1988. 'Tensar Erosion Mat' was applied to one large waterway constructed in 1988. 'Tensar' was also applied in 1989 to construct a low-level crossing at the ends of 5 diversion terraces.

Results following one year of installation in the waterways indicate that the mats can greatly benefit grassed waterway establishment and reduce first year repair costs. But if the mat is to be effective, the waterway cross-section should be parabolic, the width of the waterway required to discharge a 2-year, 24-hour rainfall event should be covered and runoff should be directed onto the mat at critical areas. Observations after one summer indicate that the Tensar Mat can also be used effectively to establish low-level, terrace end crossings.

Observations will be continued for several years to determine mat longevity and effectiveness. The displacement of the wire staples used to install the mat will also be observed although this was not a serious problem following the first winter at the waterway sites.

UNE EVALUATION PRÉLIMINAIRE DE L'UTILISATION DE TAPIS ANTI-ÉROSION LORS DE LA CONSTRUCTION DE VOIES D'EAUX ENGAZONNÉES AU NOUVEAU-BRUNSWICK

RESUME: Afin de trouver une méthode efficace pour améliorer les techniques de construction de voies d'eau engazonnees, trois types de tapis anti-érosion ont été utilisés pour six canalisations. Une couverture Curlex à faible vélocité a été utilisée sur une petite canalisation construite en 1988 ainsi que sur les parties érodées du côté supérieur et du centre de deux grandes canalisations construites en 1987. Une couverture Curlex à haute vélocité a été utilisée sur deux grandes canalisations en 1988. Un tapis Tensar anti-érosion a été utilisé pour une grande canalisation construite en 1988 alors qu'un autre tapis Tensar a été utilisé en 1989 pour construire un passage à bas niveau aux extrémités de cinq terrasses de déviation.

Selon une étude effectuée une année après leur première utilisation, ces tapis peuvent avantager l'établissement des canalisations gazonnées et réduire les coûts de réparation pendant la première année. Mais pour que les tapis soient efficaces, les canalisations doivent avoir une forme parabolique et leur largeur doit permettre aux plus fortes orages qui se produisent sur une période de deux ans d'un durée de 24 heures de recurrance de s'écouler sur un surface recouvert. Par ailleurs, le ruissellement devrait être dirigé vers le tapis aux endroits critiques. Des observations faites après un été indiquent que le tapis Tensar peut aussi être utilisé efficacement pour construire des passages de bas niveau aux extrémités des terrasses.

Nous poursuivrons nos observations pendant quelques plusieurs années afin de déterminer la durée et l'efficacité du tapis. Le déplacement des crampons métalliques utilisés pour fixer le tapis sera aussi étudié quoique ces crampons n'ont présenté aucun problème sérieux après leur premier hiver sur les lieux des canalisations.

Introduction: The Northwest and Western (Potato Belt) regions of New Brunswick have been ranked No. 1 in Canada in the annual cost of soil degradation per hectare of improved land. The annual cost of losses due to water erosion was estimated to be $14.9 million in 1989 (Agriculture Canada, 1986).

Based on estimates provided by the Universal Soil Loss Equation (USDA-SCS, 1978) it is not possible to control erosion (to less than 10 tonnes/hectare/year) on slopes greater than 5% in the NB Potato Belt even with a good rotation of potatoes-grain-hay when slope lengths are more than 300 metres. Therefore, extensive

erosion control structures including terraces are required on 25-50% of potato land and surface runoff-outlet controls such as grassed waterways are required on approximately 75% of the 50,000 hectares rotated with potatoes.

Approximately 5,500 hectares have been protected by parallel diversion terraces and associated grassed waterway and other types of outlets (e.g. surface inlets/buried outlet pipe). An average of 8,700 metres of waterways were constructed annually from 1985 to 1988 (Gartley, 1985-88). This represents an estimated annual investment of $200,000 in the construction of waterways on highly eroding potato land in NB.

Present grassed waterway construction methods involve the following procedures:

1) Determination of the waterway drainage area.

2) Runoff estimation.

3) Waterway dimension design.

4) Exact field location.

5) Topsoil removal and subsoil excavation.

6) Topsoil replacement, liming and seeding.

7) Construction of temporary ditches adjacent to the waterway (usually left in place until the following year).

8) Removal of temporary ditches after grass growth is adequate in the waterway - reseeding eroded areas as required.

The problems with current grassed waterway construction procedures are as follows:

1) It is often difficult to obtain a quick grass cover of the waterway due to the short growing season (fall constructed waterways) and frequent lack of adequate moisture to germinate seed during the summer months.

2) A rainfall/runoff event frequently occurs before the grass is established and erodes the bottom centre portion of the waterway and/or the temporary ditches.

3) Although the temporary ditches protect the waterway from field runoff, the ditches may result in gullies forming on either side of the waterway, particularly if the ditches are left over winter.

4) Farming activities are disrupted as the temporary ditches cannot be crossed with farm equipment.

5) The land improvement contractor has to return to the farm several months or even one year later to remove the temporary ditches and reseed eroded areas.

Fibre netting erosion control mats are commonly used in the northeast U.S. for grassed waterway construction (McCandless, 1988). Several types of erosion control matting products are readily available through New Brunswick suppliers. Therefore, a study was initiated in 1988 to demonstrate the use of erosion control mats in the construction of conservation systems, to determine the capital and maintenance cost savings resulting from use of the matting and to determine which type or combination of erosion control mat is the most effective and cost efficient.

Materials and Methods: Five sites with existing grassed waterways or where waterways were being constructed during 1988 were selected for mat demonstration and installation (Table 1). The sites varied in drainage area and slope from 4.9-53.8 ha and 5.5-10.0% respectively. The largest waterway was 457 m long and 12 m wide while the smallest was 277 m long and 7 m wide.

Three types of mat products were purchased from a local distributor. The products were the Curlex lo-velocity and hi-velocity degradable fibre blanket and the Tensar multi-layered, polyethylene netting (Table 2).

TABLE I

SITE DESCRIPTION

SITE	LOCATION	DRAINAGE AREA ha	(ac)	AV.SLOPE %	LENGTH m	(ft)	WIDTH[2] m	(ft)	DEPTH m	(ft)	COMMENTS
1	Hartland	16.6	(41)	5.5	457	(1500)	12	(40)	N/A		Constructed 7/88 Installed mat 7/14/88
2	St. Leonard	53.8	(133)	10.0	152	(500)	14	(45)	0.3	(1.0)	Constructed 7/88 Installed mat 26/7/88
3	Florenceville	4.9	(11)	9.0	277	(684)	7	(24)	0.3	(1.0)	Constructed 6/88 Installed mat 7/7/88
4	Drummond	13.0	(32)	10.0	198	(650)[1]	15	(50)	0.3	(1.0)	Constructed 8/88 Installed mat 29/7/88
5a	Ennishore	41.3	(102)	6.0	229	(750)[1]	14	(45)	0.3	(1.0)	Constructed 1987 Installed mat 25/7/88
5b	Ennishore	30.0	(74)	5.5	320	(1050)[1]	15	(50)	N/A		Constructed 1987 Installed mat 25/7/88

1) Length D/S of field road culvert
2) Width at bottom of waterway (maximum width of W.W.)

TABLE 2

EROSION MAT PRODUCTS

TYPE	Manufacturer[a]	DESCRIPTION	ROLL SIZE
1) CURLEX BLANKET LO-VELOCITY	AMERICAN EXCELSIOR	DEGRADABLE WOOD FIBRE MAT, 2.5 X 5.0 CM LIGHT NYLON MESH ONE SIDE ONLY	1.2 X 54.9m
2) HI-VELOCITY	AMERICAN EXCELSIOR	DEGRADABLE WOOD FIBRE MAT, 1.7 X 1.7 CM, HEAVY NYLON MESH BOTH SIDES	1.2 X 30.5m
3) TENSAR MAT	TENSAR CORPORATION	NON-DEGRADABLE, MULTI-LAYERED, POLYETHYLENE, UV STABILIZED NETTING	1.5 X 30.0m

a) Mention of trade names does not imply endorsement by the NBDA.

Mats were installed in 1988 by NBDA staff following waterway construction/repair and seeding. The centers of the waterways at sites 1 and 3 had been slightly eroded and had to be hand-raked and reseeded prior to mat installation. All waterway construction procedures followed normal NBDA standards and recommendations except that temporary ditches were not used (temporary ditches were constructed and then partially removed at site 4). Labor and other expenses were recorded and unit and total mat installation costs were calculated (Table 3).

TABLE 3

MAT INSTALLATION COSTS

SITE	TYPE	MAT INSTALLATION LENGTH m (ft)	WIDTH m (ft)	AREA m^2 (ft^2)	INSTALLATION COSTS (1988 $) MATERIALS[1]	LABOR[2]	TOTAL	$/AREA $/$m^2$	($/$ft^2$)
1	CURLEX HI	244 (800)	3.7 (12)	892 (9600)	$ 4,802	$ 293	$5,095	$5.71	($0.53)
2	TENSAR	131 (430)	4.5 (15)	590 (6342)	8,954	385	9,339	15.82	($1.47)
3	CURLEX LO	220 (720)	2.4 (8)	527 (5760)	1,274	128	1,402	2.66	(0.24)
4	CURLEX HI[3]	61 (200)	6.1 (20)	372 (4000)	1,665	237	1,902	5.11	(0.48)
5a	CURLEX LO	Av. 30 (100)	8.5 (28)	268 (2880)	637	198	835	3.12	(0.29)
5b	CURLEX LO	110 (360)	2.4 (8)	268 (2880)	637	99	736	2.74	(0.26)

1) Based on retail price F.O.B. Florenceville, NB for mats and staples.

2) Based on $9.59/hr (NB Government Labor Rate) includes ½ ton vehicle rental for delivery of material and labor to site.

3) Not including lo-velocity mat installed at bottom of waterway.

Mats were installed using recommended wire staples 15 cm in length with a 2.5 cm crown following the stapling pattern displayed on the Curlex package. A stapling pattern was not recommended for the Tensar so the same pattern as recommended for the hi-velocity Curlex was used. Staples were driven using rubber mallets.

Specific recommendations for the width and length of mat to be installed were not available. The Curlex product literature recommended using the hi-velocity blankets where velocities would be 1.6 - 3.4 m/s depending on the soil type. No specific velocity recommendations were available for the Tensar. Therefore, it was decided to install the Curlex lo-velocity in the smaller waterways designed for less then 1.2 m/s velocities and use the hi-velocity Curlex and Tensar in the larger waterways expected to experience higher velocities.

In addition to the waterway installations, a 3 m x 10 m Tensar mat was installed May, 1989 at the outlet end of 5 diversion terraces to assist with the establishment of low-level crossings. The mats were installed following diversion terrace construction and seeding in 1989. The matting covered the terrace channel from the end of the berm, across the field road to the bottom of the terrace outlet ditch. (The bottom of the outlet ditch was approximately 0.6 m below the terrace channel).

Observations and Results: The performance of the erosion control mats installed in the grassed waterways was observed during and/or following runoff events occurring from installation in 1988 to late fall, 1989. The mat performance at the ends of the

diversion terraces was observed from installation in 1989 to late fall, 1989.

Site 1: The hi-velocity matting installed at this site suffered severe damage during a substantial runoff event which occurred several hours after installation. Since only 244 m of the 457 m long waterway had mat coverage and the waterway was bare, a large volume of soil was eroded and transported form the upper portion of the waterway and deposited on the mat. Also, since the waterway cross-section was quite flat, runoff caused small gullys to form along the edges of the mat. Large runoff events in August, 1988 increased silting and gullying. Consequently, the waterway was regraded. By September, 1988 good grass cover was forming where the mat had not been covered with silt. This portion of the waterway remained in fair condition in 1989 but the remainder of the waterway was graded again and was not established in grass by the fall.

The poor performance of the mat in this waterway was mainly a result of too little matting being used in a waterway where velocities were much greater than 1.2 m/s. Only 3.7 m of the 12.2 m wide waterway had mat coverage. Based on a permissible velocity of 1.2 m/s the full width of the waterway would have to be covered at the outlet end. Also, due to the large flow volumes in the upper portion of the waterway matting should have been installed up to at least the junction of the waterway and the top terrace outlet.

Site 2: Site 2 involved the stabilization of a gully draining 53.8 ha. The Tensar matting performed very well in stabilizing the backfilled gully. Some runoff was observed running along the edges of the mat Spring, 1989. This was mainly due to frost heaving and snow and ice blockage in the mat channel. Later in the spring, runoff flow returned to the centre of the channel and very little damage was done along the edges of the mat. Some frost heaving of the wire staples at the upper end of the mat was observed but this was in an excessively wet area. No tire damage was reported following mowing of the waterway. Immediately below the end of the mat a gully approximately 0.6 m deep had formed. Therefore, without the mat, the waterway would have been washed out. The mat had not deteriorated or loosened following one year of installation.

Site 3: Lo-velocity Curlex was installed in this small waterway. A runoff event (estimated to be the result of a 2-year storm) which covered more than the width of the mat was observed one month after installation. The mat held but the fibre was moved between the mesh and the ground and was rilled between the staples. But, since most of the waterway's length was covered with mat and some grass cover was beginning to establish on the sides of the waterway very little silt was deposited on the mat. Also, no gullying along the outside edges of the mat was observed since the waterway cross-

section had a uniform parabolic shape which encouraged runoff to flow on the mat.

The mat held well throughout 1988-89 and a good grass cover was established through the mat. A deterioration of the mat fibre was evident in 1989 suggesting that the mat fibre would be degraded by 1990. Two years after installation, the wire staples could still be found but were embedded in the soil. The waterway had been mowed and crossed with farm equipment; no tire damage was reported.

Site 4: A combination of hi-velocity mat in the centre and lo-velocity mat along the outside edges was installed in this waterway. The matting suffered a severe runoff event prior to installation being completed. Concentrated flow from the previously constructed diversion damaged the edges of the mat. Also, since grass cover was not properly established during the storm event silt from the diversion was deposited on the bottom of the mat where the waterway slope decreased. The waterway cross-section was almost trapezoidal and runoff tended not to flow in the centre of the mat on the steeper sections of the waterway.

Even with these problems, the mat placed in this waterway kept it from being completely eroded and aided the establishment of some grass cover. Strategically placed straw bales could have been used to prevent some of the waterway damage.

Sites 5a & 5b: Lo-velocity Curlex was installed to repair small washouts in these waterways constructed in 1987. The matting was useful in the repair of waterway 5a but runoff tended to travel along the outside edges of the mat in waterway 5b.

Low-level terrace crossings: By the fall, 1989 grass was well-established through the Tensar mat. Several moderate runoff events had occurred but the Tensar had prevented the crossings from being eroded.

General: Due to the large amount of rocks found in NB potato soils and used for waterway construction, wire staples greater than 15 cm in length would be very difficult to drive into the mat and soil. Generally, the mat products were very easy to use. Rolls could be carried by 2 persons and a half-ton truck could easily transport the materials. Although mat installation times were longer than stated in Curlex product literature, adequate matting could be installed in a large waterway by 2-4 persons in one day.

Deterioration of both the degradable and non-degradable mat products, wire staple displacement and/or degradation and the condition of the waterways will continue to be observed for the next few years.

An analysis of the waterway design at sites 1-4 was done to compare the width of mat required to discharge a 2 year storm to the width actually installed (Table 4). This indicated that a wider mat width would be required at each site. This agrees with the observations. For example, at Site 3 runoff was observed flowing at a width greater than the 2.4 m mat width. If this had occurred when the field and edges of the waterway were bare the mat and waterway would have been damaged. Installing a mat with a width of 4.9 m at the waterway outlet would have ensured protection of the waterway for all but extreme events not expected to occur in the next year.(i.e. the time required for a sod cover to be established)

TABLE 4

MAT REQUIREMENTS

SITE	MAT TYPE	PEAK Q1[1] CMS(cfs) 2 YEAR	10 YEAR	DESIGN WIDTH[2] m (ft.) W. W.	MAT	ACTUAL WIDTH m (ft.) W. W.	MAT
1	Curlex Hi	0.8(29)	2.7(95)	21.3(70)	12.2(40)	12.2(40)	3.7(12)
2	Tensar	--	2.9(104)	--	7.6(25)[3]	14.0(45)	4.5(15)
3	Curlex Lo	0.3(9)	0.8(29)	8.2(27)	4.9(16)	7.3(24)	2.4(8)
4	Curlex Hi	0.5(19)	1.7(59)	15.2(50)	9.4(31)	15.0(50)	6.1(20)

1) - 2 year storm-fallow, 10 year storm - potatoes. Calculated using SCS-TR55 or E.Desk.Pk.

2) - Based on permissible velocity of 1.2 m/s (4 fps) for Curlex (from exhibits 7.3 and 7.4, USDA-SCS Eng. Field Manual) and 3.3 m/s (10 fps) for Tensar.

3) - Based on d = 0.2 m (0.5 ft) and T = 9.5 m (31.0 ft.)

Conclusions: Since the mat products have been installed less than two years the following conclusions should be considered to be preliminary:

1) When erosion control mats are to be installed, waterways should be constructed with a parabolic cross-section and/or other techniques should be used to encourage runoff to flow on the mat.

2) The width of a degradable mat applied to a waterway should be equal to or greater than the width of the waterway required to safely discharge a 2-year storm at

the design, permissible velocity for a grassed waterway (Table 4).

3) Degradable, hi-velocity mats have limited application since a grassed waterway should be designed considering grass cover only after 2-3 years.

4) Non-degradable, hi-velocity mats are useful in large discharge, high-velocity situations in place of rock centres, large pipes, etc. But, the width of the waterway required to discharge a 10-year storm at the high (design) velocity should be covered with mat.

5) Mats should be 'keyed-in' at the top end and at flow junction locations along the sides to encourage runoff to flow on the mat.

6) Erosion control mats are easy to install and do not require much installation labor; - local land improvement contractors would be able to provide installation services.

7) 15 cm wire staples can be used for mat installation. But plastic or wooden pins should be used in very poorly drained areas subject to frost heaving if equipment traffic is expected.

8) Use of the non-degradable mats in common grassed waterways designed for less than 1.2 m/s will increase the waterways initial construction costs by 25-50%. But the benefits of greatly reduced maintenance costs, no erosion or disruption of farming operations due to temporary ditches, no waterway reseeding and completing the project in one season should outweigh the mat costs.

9) Depending on the type of project and available materials use of the non-degradable mat may be less expensive than pipe installation. Also, use of the mat provides for surface flow eliminating concern over blockage of the inlets to underground pipe or the need for large event overflow systems.

10) Observations of existing installations should be continued for several years. Also, other available mat products should be considered to determine their availability, application and cost.

REFERENCES

1. Agriculture Canada, 1986. A Preliminary Economic Assessment of Agricultural Land Degradation in Atlantic and Central Canada and Southern British Columbia, Regional Development Branch.

2. McCandless, Donald, 1988. Northeast National Technical Centre, USDA-SCS, Chester, Pa. - personal communication, 1988 A.C.A.E. Workshop.

3. Gartley, C., 1985-88 Soil and Water Engineering Activity Reports 1985-88, Soil & Water Section, Agricultural Resources Development Branch, NBDA, Fredericton, NB.

4. USDA-SCS, 1978. Predicting Rainfall Erosion Losses - A Guide to Conservation Planning, Handbook 537.

AERIAL MONITORING OF POTATO INFESTING APHIDS IN NEW BRUNSWICK IN 1989

ENQUETE SUR LES VOLS DE PUCERONS INFESTANT LES POMMES DE TERRE AU NOUVEAU BRUNSWICK EN 1989

GUY BERNARD

ABSTRACT:

Green peach aphid catches were generally low for the 1989 season. The greatest numbers were caught during the last two weeks of August. Relatively high numbers of green peach aphids were detected in yellow pan traps around mid-June. Buckthorn aphid numbers reached record levels in 1989.

RESUME:

Les captures de pucerons verts du pêcher furent généralement basses durant la saison 1989. Les captures les plus importantes furent effectuées durant les deux dernières semaines du mois d'août. Des nombres relativement élevés du pucerons verts du pêcher furent détectés dans les pièges jaunes vers la mi-juin. Les captures de pucerons du nerprun atteignirent des niveaux records en 1989.

Aphids, mainly because of their ability to transmit virus diseases, are an important pest of potatoes. The Green Peach Aphid (Mp), in particular, is the major vector of PLRV (leafroll) and an efficient vector of PVY (mosaic). Both of these diseases account for a substantial proportion of the seed field rejections each year in New Brunswick. Aphid populations have been monitored extensively in the Province since 1974 and a warning service based on aphid catches in yellow pan traps has been available to potato producers ever since.

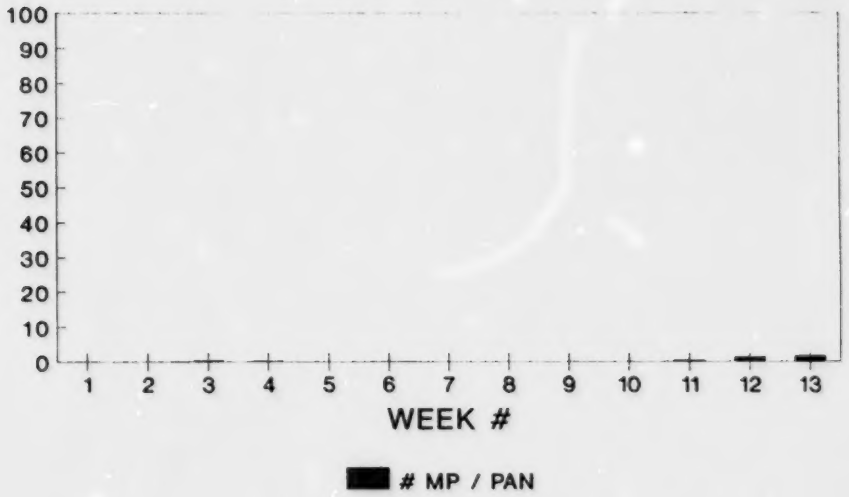
In 1989, 106 yellow pan traps were operated in the province mostly in the counties of Carleton, Victoria and Madawaska. Contents of yellow pan traps are collected by growers in seed fields and by scouts in table and processing potato fields. Samples are brought to the Agricultural Resource Centre in Wicklow for identification. As part of the aphid advisory service, weekly reports on aphid flights, based on these trappings, are sent to cooperating farmers, inspectors and others during the growing season. Information is also made available to all growers through the use of a toll-free telephone answering service, and personal letters to producers. Potato growers are advised to apply a topkiller to seed crops as soon as possible after the occurrence of a major green peach aphid flight in their region.

The first catches of the season occurred as early as June 19th in Victoria Corner and Jacksonville. On June 20th as many as three green peach aphids were captured in a single pan in Weston. From June 20th to June 27th, single catches were recorded in many localities from Woodstock to Plaster Rock and from July 14th until the end of the season, small numbers of Mp were caught regularly in most localities. Significant average catches of more then one Mp/pan/week did not occur this year until the end of the season (Graph 1,2).

Catches of the buckthorn aphid (An) are not usually very high in yellow pan traps. Average catches of more than one aphid/pan/week are rare. Nevertheless, record numbers of buckthorn aphids were captured in 1989 and levels of 9.53 and 11.63 aphids/pan/week were observed early in the season from mid to late June (Graph 3). Catches of the common potato aphid (Me) were lower than average in 1989. The greatest numbers were also captured early in the season from mid to late June (Graph 4). Of these two aphid species, only the buckthorn aphid is thought to be able to play a significant role in PVY transmission. Catches of other aphid species (Ot) were slightly above average in 1989 (Graph 5).

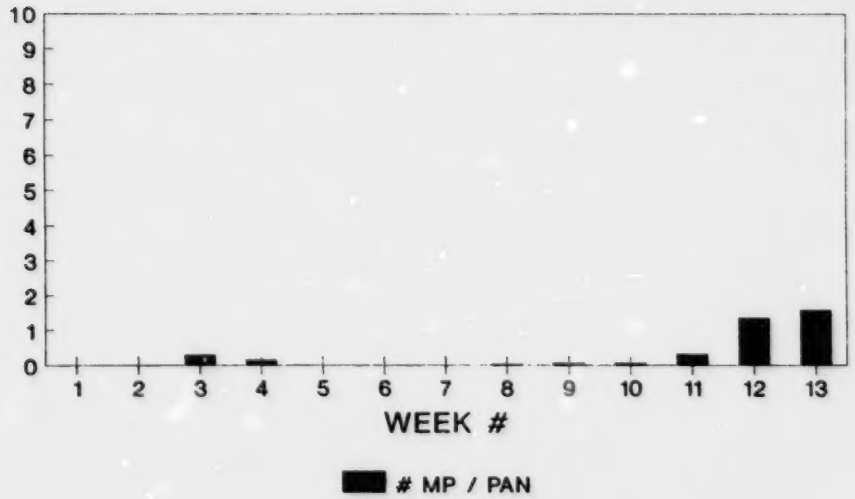
GRAPH #1

GREEN PEACH APHID CATCHES
1989



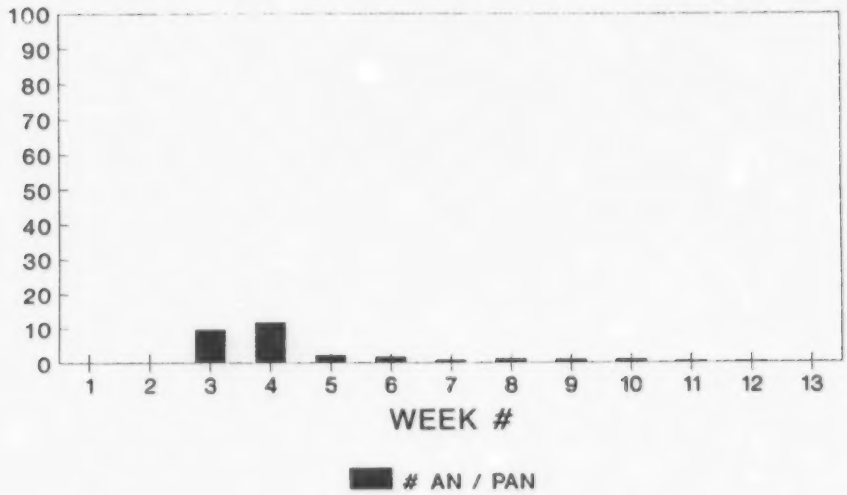
GRAPH #2

GREEN PEACH APHID CATCHES
1989



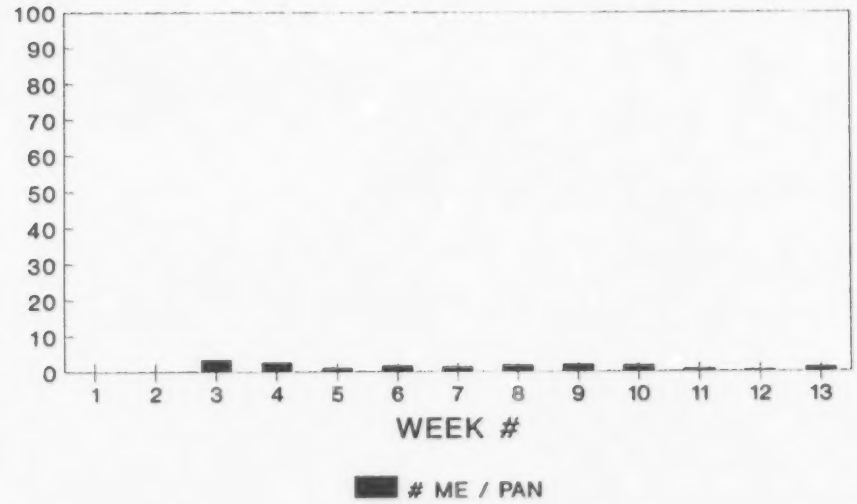
GRAPH #3

BUCKTHORN APHID CATCHES
1989



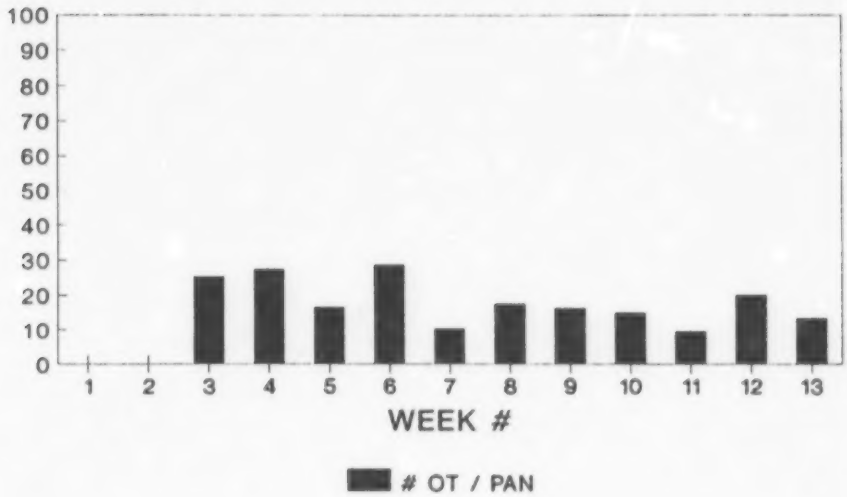
GRAPH #4

COMMON POTATO APHID CATCHES
1989



GRAPH #5

OTHER APHID CATCHES
1989



MONITORING OF INSECT POPULATIONS IN POTATO FIELDS IN 1989

ENQUETE SUR LES INFESTATIONS D'INSECTES DANS LES CHAMPS DE POMMES DE TERRE EN 1989

GUY BERNARD

ABSTRACT:

Aphid populations were generally low during the 1989 season. Infestations, however , occurred earlier than usual in potato fields. Colorado Potato Beetle populations were high and unusually large numbers of adults appeared in potato fields in the spring and during the month of August. Flea Beetle populations were also abnormally high during the month of August.

RESUME:

Les populations de pucerons furent généralement basses durant la saison 1989. Les infestations cependant, débutèrent plus tôt qu'à la normale dans les champs de pommes de terre. Les populations de doryphores furent élevées et un grand nombre d'adultes apparurent dans les champs de pommes de terre au printemps et durant le mois d'août. Les populations d'altises furent également anormalement élevées durant le mois d'août.

The most common insects in potato fields in New Brunswick are the Colorado Potato Beetle, several species of colonizing aphids and the Potato Flea Beetle. Colorado Potato Beetles are chewing insects. They can cause substantial reductions in yield if defoliation is extensive and occurs during a sensitive growth period.

Aphids are sucking insects. Many are vectors of virus diseases and as such, they are of particular concern to seed growers since tolerances for viruses are low in seed crops. Aphids can also reduce yields if infestations are severe.

Potato Flea Beetles are small insects which chew holes in potato leaves. Yield reductions are most likely to occur only if populations are very high late in the season.

In 1989, insect populations were monitored weekly in 35 fields in the potato belt. A sample area was established in each field early in the spring and data was collected from within the plot for a period of 13 weeks.

Aphid populations were estimated by counting the number of winged and wingless aphids of each species on the whole surface of one bottom, one middle and one top leaf per plant on a total of 30 plants per plot. This differs from the procedure used in 1988, where because of extremely high infestations, aphids were counted only on the terminal leaflets of such leaves.

Colorado Potato Beetle infestations were evaluated by counting the number of larvae as well as adults in each plot on a total of 30 whole plants. Defoliation data was also collected for the first time in 1989.

Flea beetle damage was evaluated by counting the number of feeding holes on the terminal leaflet of the fourth leaf from the top of the plant on 14 plants per plot.

The main purpose of this data collection in potato fields has always been to provide growers with timely and easy to understand information that would help them better schedule insecticide applications and avoid unnecessary treatments.

In 1989, as in previous years, an HP85 microcomputer was used to produce reports in the field immediately after monitoring. The reports clearly show the trends in aphid populations and provide growers with a visual evaluation of the success or failure of insecticidal treatments (Graph 1).

Data collected from the 35 fields sample is also used to provide information to all growers on field populations of insects. This information is available through the use of a toll-free telephone answering service and personal letters to producers.

To summarize the 1989 insect monitoring season: The percentage of fields infested by Potato Flea Beetles was higher than usual in the spring. Infestation levels remained very high but decreased gradually as the summer progressed only to reach unusually high levels again throughout the month of August. Infestations were severe enough, in some cases, to warrant treatment with foliar insecticides.

Aphid populations were generally low during the 1989 growing season. Infestations however, occurred earlier than usual in potato fields. The buckthorn aphid was the most numerous species in 1989.

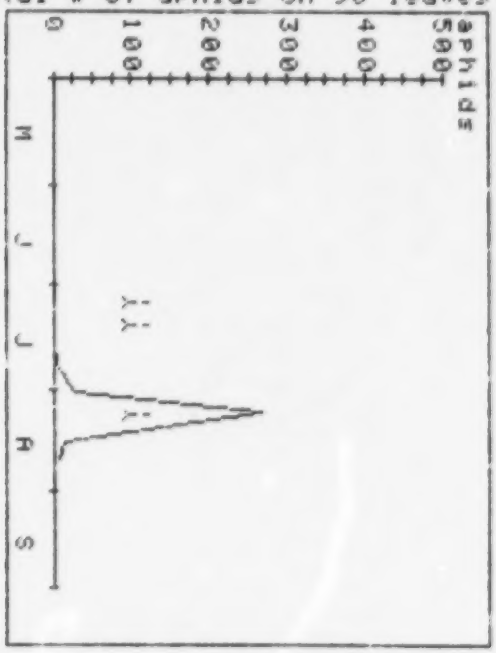
Colorado Potato Beetle populations were high again this year. Unusually high numbers of overwintering adults appeared in the spring and in some instances caused damages to portions of fields soon after emergence. The percentage of fields infested with both adults and larvae remained high throughout the season. Unusually large numbers of adults were detected in fields throughout the month of August but defoliation levels were not severe enough to justify treatment with an insecticide. Colorado Potato Beetles were hard to control, this year again, with chemical insecticides.

The following graphs (Graph 2 to 12) are based on the data gathered in 35 potato fields during the summer of 1989. Although strongly biased by insecticide applications, they have nevertheless been included for the record and to provide a continuing basis for comparisons.

GRAPH #1

GROWER# 5
DATE:AUGUST 22
INSECTICIDE APPLICATIONS
7 / 6 SUPRAC 0 5L/A
7 / 13 THIODAN .5L/A
8 / 9 PIRIMOR 2.5KG/A

APHID POPULATION CURVE
total # of aphids on 90 leaves

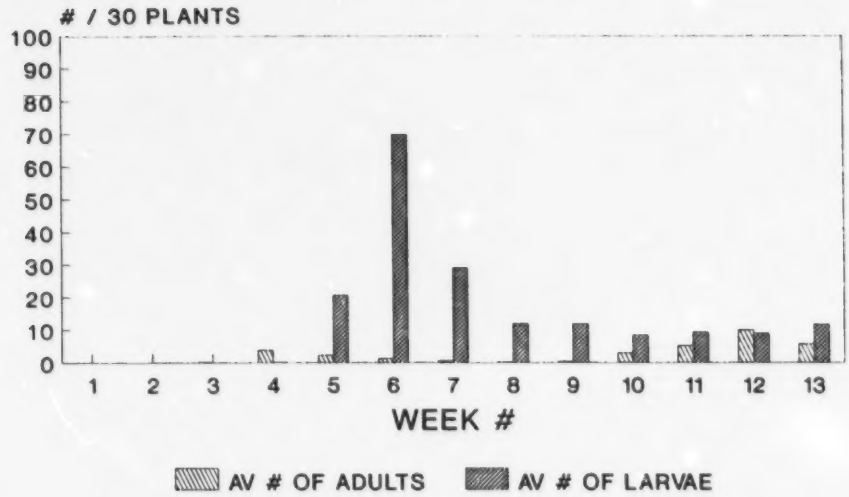


OF THE 9 APHIDS COUNTED
IN YOUR FIELD TODAY
1 WERE GREEN PEACH WINGED
3 WERE GREEN PEACH
0 WERE POTATO WINGED
5 WERE POTATO
0 WERE BUCKTHORN WINGED
0 WERE BUCKTHORN

19.8 % OF THE PLANTS
WERE INFESTED
AVERAGE FLEA BEETLE DAMAGE = 0
HOLES/LEAF
COLORADO BEETLES WERE DETECTED
IN YOUR FIELD
FOR MORE INFORMATION CALL GUY BE

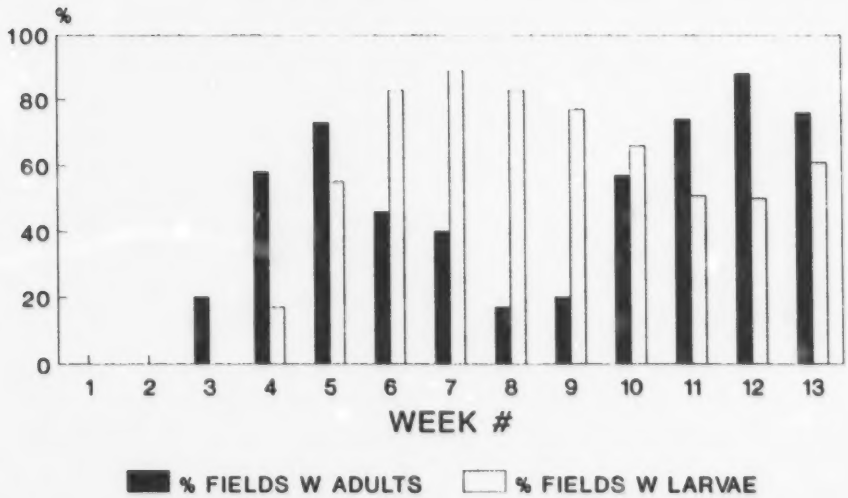
GRAPH #2

FIELD MONITORING 1989
COLORADO BEETLES



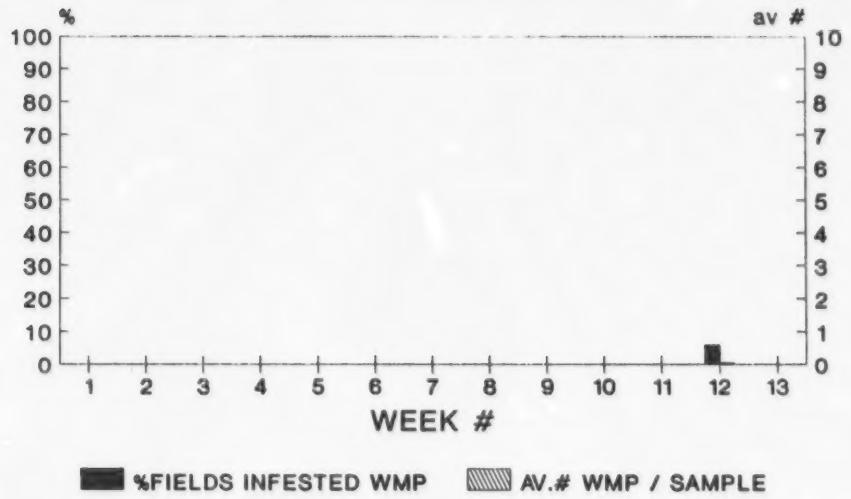
GRAPH #3

FIELD MONITORING 1989
COLORADO BEETLES



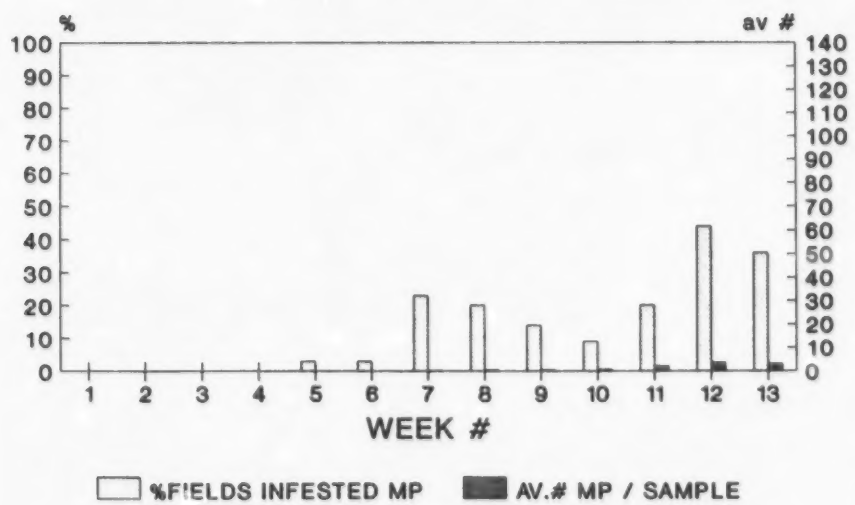
GRAPH #4

FIELD MONITORING 1989
GREEN PEACH APHIDS



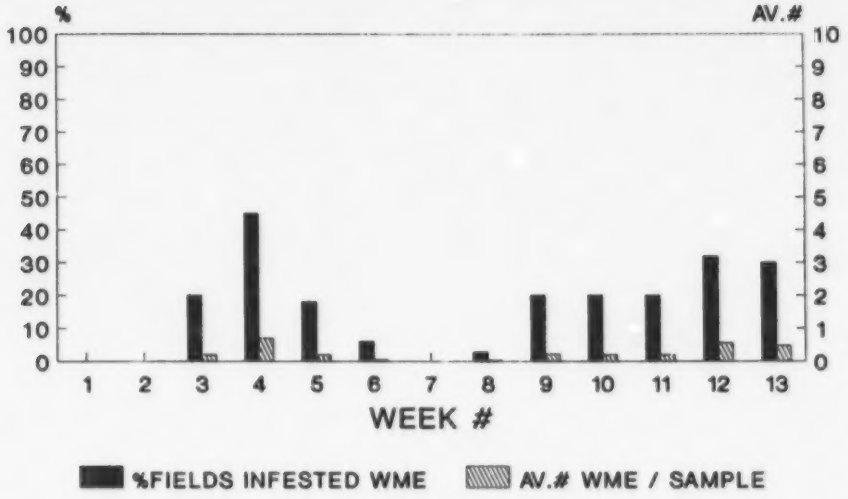
GRAPH #5

FIELD MONITORING 1989
GREEN PEACH APHIDS



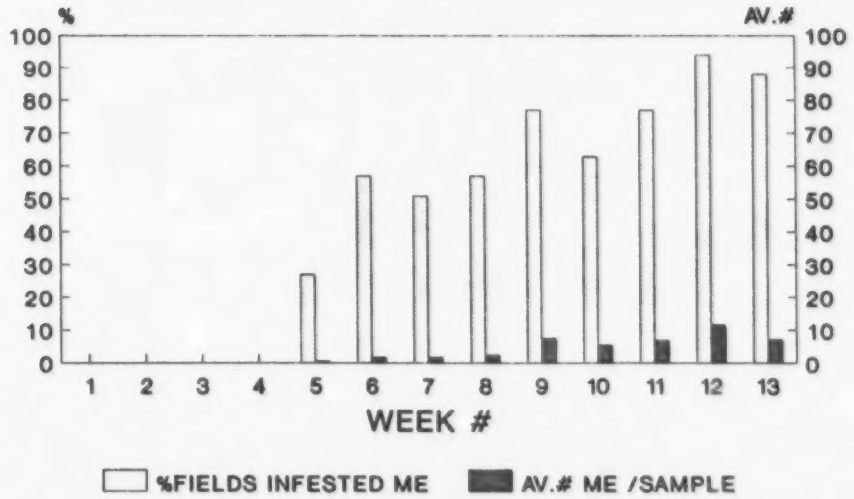
GRAPH #6

FIELD MONITORING 1989
COMMON POTATO APHIDS



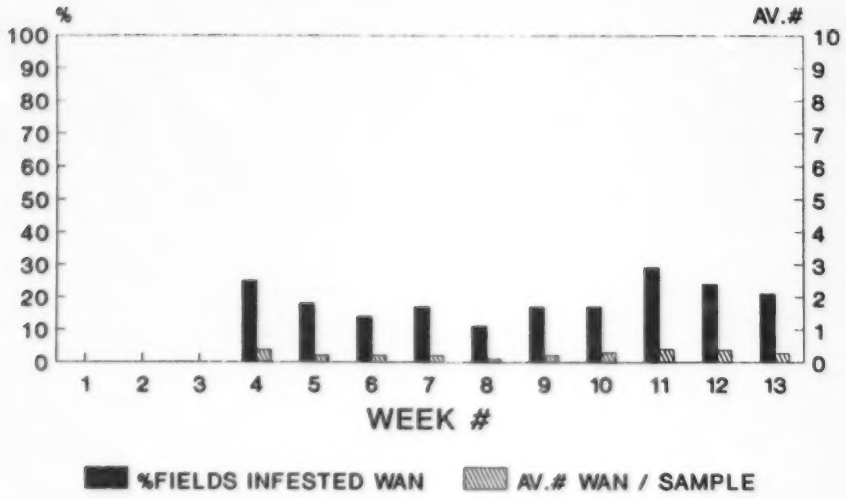
GRAPH #7

FIELD MONITORING 1989
COMMON POTATO APHIDS



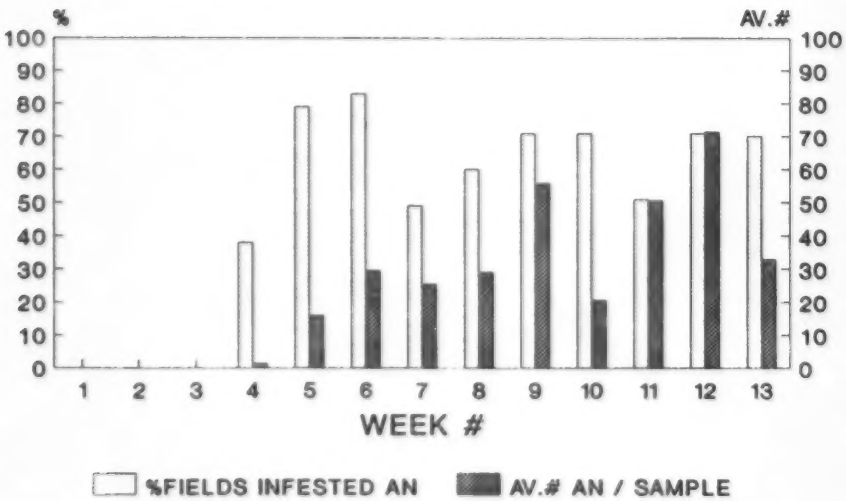
GRAPH #8

FIELD MONITORING 1989
BUCKTHORN APHIDS

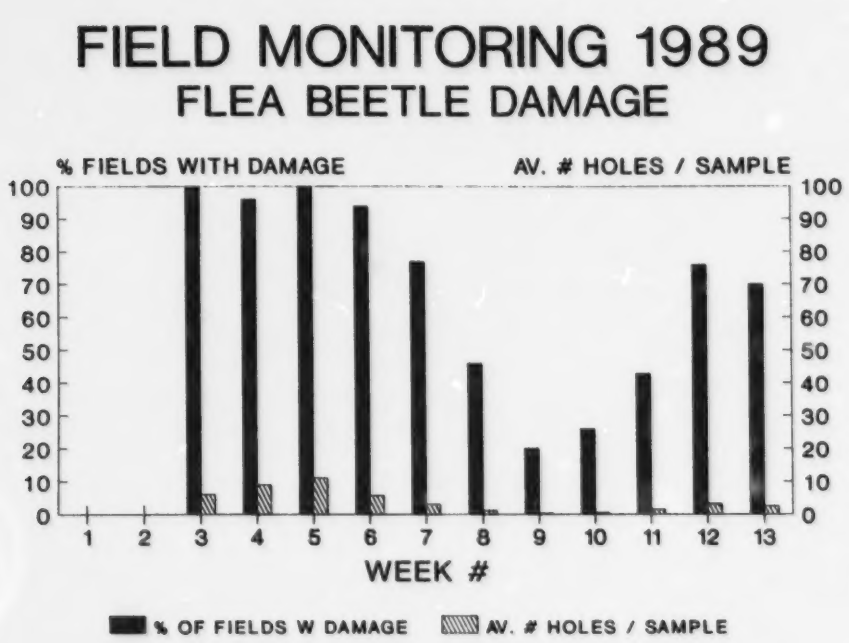


GRAPH #9

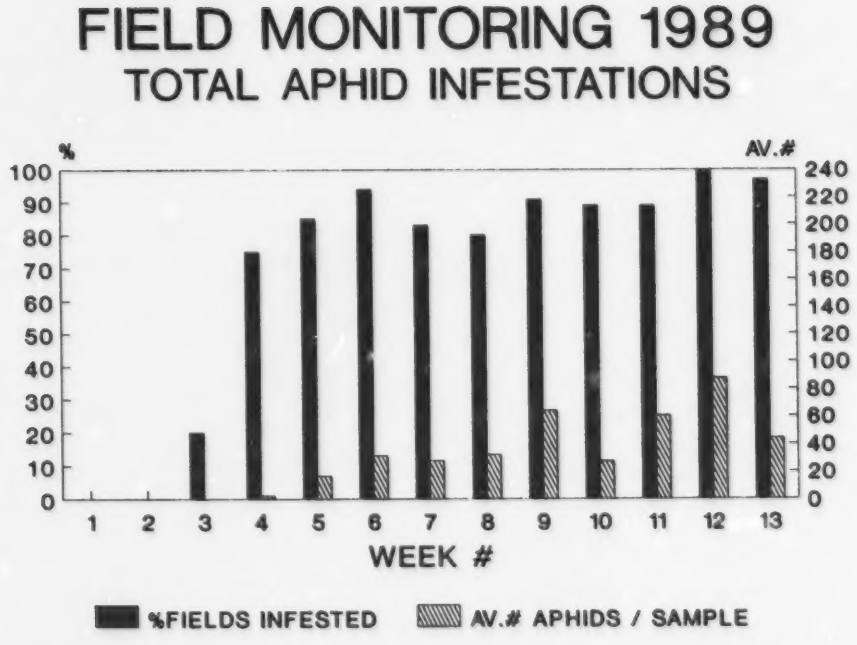
FIELD MONITORING 1989
BUCKTHORN APHIDS



GRAPH #10

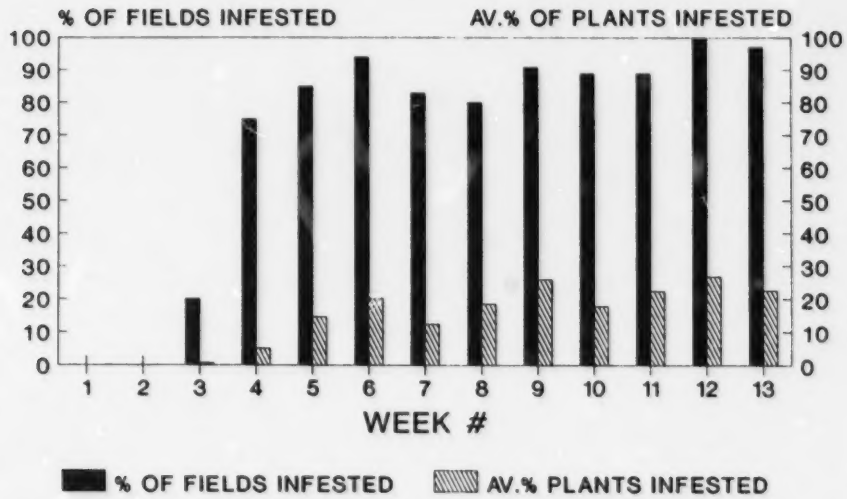


GRAPH #11



GRAPH #12

FIELD MONITORING 1989
% OF PLANTS INFESTED



INSPECTION OF GREENHOUSES FOR THE PRESENCE OF POTATO INFESTING APHIDS IN 1989

INSPECTION DES SERRES EN 1989, POUR LA PRESENCE DE PUCERONS INFESTANT LES POMMES DE TERRE

GUY BERNARD

ABSTRACT:

Green peach aphids were found in 4 of the 23 greenhouses inspected in the spring of 1989. Winged forms of the green peach aphid were also present in 3 of these greenhouses.

RESUME:

Des pucerons verts du pêcher furent détectés dans 4 des 23 serres inspectées au printemps de 1989. Des puçerons verts du pêcher de forme ailée étaient présents dans 3 de ces serres.

Many species of aphids can play a role as vectors of virus diseases. The green peach aphid, in particular, is the principle vector of PLRV (Leafroll) and an efficient vector of PVY (Mosaïc) to potatoes. Both diseases can cause yield reductions if seed tubers are affected. In addition, plants of susceptible varieties infected with PLRV will often develop a tuber disorder, known as net necrosis, which greatly affects the quality of table and processing potatoes.

These two diseases, leafroll and mosaïc, account for a substantial proportion of seed field rejections each year in New Brunswick. Since the tolerance for virus diseases in seed crops is low, seed growers are acutely aware of the potential for disease transmission from aphids alighting in their fields.

The green peach aphid overwinters on peach trees in southern locations. Closer to us, in the State of Maine, it often overwinters on the Canada plum in the form of eggs. In New Brunswick however, the green peach aphid does not ordinarily overwinter on the Canada plum but it can survive the winter in greenhouses.

In a 1988 survey of 27 greenhouses, conducted in the potato belt of New Brunswick from June 8th to June 13th, 14 greenhouses were found to be infested, sometimes heavily, with green peach aphids. Winged forms were present in 4 of these greenhouses. Since plants from these greenhouses were sold and distributed widely throughout potato growing areas, there is a possibility that the aphids they harbored could have become an early source of infestation in seed fields.

Early infestations of seed fields by aphids can substantially increase in-field virus transmission if inoculum levels are high in the crop.

Unfortunately, because of a record green peach aphid flight in 1988, high inoculum levels were expected to prevail in potato fields in the Spring of 1989.

In an attempt to reduce local sources of green peach aphids, all greenhouse operators in the province were contacted in the Spring of 1989 and were asked to cooperate by making sure that all the plants they sold were free of aphids. In a follow-up survey of 23 greenhouses which was conducted in the potato belt on May 16th and 17th 1989, small numbers of green peach aphids were detected in 4 greenhouses. Winged forms of the green peach aphid were also present in 3 of these. Small numbers of aphids belonging to the aphis spp. and which may have included some buckthorn aphids were also detected in 8 greenhouses. Most greenhouse operators indicated during the survey that they had become aware of the problems caused by aphids in potato fields and were therefore trying to achieve better aphid control. Fifteen (15) of the 23 greenhouses inspected were completely free of aphids at the time of inspection.

EVALUATION OF BACILLUS THURINGIENSIS FORMULATIONS FOR THE CONTROL OF COLORADO POTATO BEETLES.

EVALUATION DE DIFFERENTES FORMULATIONS DE BACILLUS THURINGIENSIS POUR LE CONTROLE DU DORYPHORE DE LA POMME DE TERRE.

GUY BERNARD

ABSTRACT:

Several B.t. formulations were tested in 1989 for their effectiveness against the larval stages of the Colorado Potato Beetle. When compared with the control, all the products tested were useful in diminishing larval populations and preventing drastic reductions in yield.

RESUME:

On fit l'essai en 1989, de plusieurs formulations de B.t. afin de déterminer leur efficatité contre les stages larvaires du doryphore. Lorsque comparés au contrôle, tous les produits furent utiles à diminuer les populations larvaires et à prévenir des réductions importantes de rendement.

INTRODUCTION:

Colorado potato beetle populations have been on the increase in recent years in New Brunswick. Both the larvae and the adult of the beetle are capable of causing substantial damage to potato plants. While plants are normally able to compensate for some damage, yield reductions are likely to occur if defoliation is too severe or if it is inflicted during a sensitive growth period or a period of stress.

The most common methods of reducing colorado potato beetle damage to potato crops in New Brunswick are the use of crop rotations and the use of chemical insecticides either banded in the soil at planting or sprayed on the foliage during the growing season.

The purpose of this experiment was to evaluate the use of Bacillus thuringiensis (B.t.) as an alternative control method.

[B.t. products are designed to be sprayed on the leaves. They must be ingested by the very young larvae in order to be effective. They are highly specific and are considered harmless to other insects which may be present in potato fields.]

MATERIALS & METHODS

A randomized complete block design was used for this experiment. Treatments were as follows:

1.	THIMET 15 G	A granular insecticide used at planting at a rate of 20 kg/ha.
2.	M-ONE	A 12.5% water dispersable suspension of B.t. used at a rate of 5 L/ha.
3.	MYX 9858	A 9% oil concentrate formulation of B.t. used at a rate of 3.75 L/ha.
4.	AMBUSH	A synthetic pyrethroid insecticide used at a rate of 0.2 L/ha.
5.	CONTROL	Only water was used in this treatment.
6.	MYX 1806	An aqueous solution containing 10% encapsulated endotoxin of B.t. used at a rate of 5 L/ha.

The experiment was planted on May 19th, 1989 on ground previously planted to potatoes and left untreated. Each treatment was replicated four times and consisted of two 4.57 m rows of Red Pontiac potatoes spaced 0.91 m apart. Seed spacing was 30.5 cm between sets. Each seed piece was cut in advance to a weight of 50 g $\pm$ 5 g. Sets were planted by hand to ensure uniformity and accuracy. Fertilizer was applied with a conventional planter at a rate of 896 kg/ha of 15-15-15. A 0.91 m wide strip of wheat, which later formed a dense barrier, was seeded around each treatment after potato emergence to impede the movement of larvae between plots. Weeding and hilling operations were done by hand. A conventional 13 L hand sprayer was used to apply the foliar treatment.

Dithane M-45 and Ridonil MZ were used to control foliar diseases.

Foliar applications of each of the B.t. formulations, Ambush and water for the control were made on each of the following dates: June 27, July 4, July 12, and July 20. The July 4 application was followed by a drenching rain.

Reglone, a topkiller, was applied to the experiment on August 18, as soon as it became apparent that adult beetles were starting to migrate and cause damage to adjacent plots. The plots were harvested and yield data was collected on September 11 and 12, 1989.

Observations on beetle numbers were collected on June 27, July 5, 6, and 7, and July 17 and 18. In all instances, data were collected on all plants in each treatment.

RESULTS

Adult beetles were abundant on the site of the experiment at emergence around June 5. The first egg masses were observed on June 12. The first young larvae (1st instar) were observed on June 23.

A count was conducted prior to spraying on June 27 to determine if there were large differences in infestation levels for each treatment, which may later influence the outcome of the experiment.

The results indicate (Graph 1, Table 1) that the beetles avoided the Thimet 15 G treatment. There were no appreciable differences in the number of adults or the number of egg masses present on plants in other treatments.

A second count was conducted on July 5, July 6 and July 7 soon after the second spray, to determine the effect of the different treatments on the abundance of each larval stage. The Thimet 15G and the Ambush treatments were the only ones to effectively reduce the number of 1st instar larvae (Graph 2, Table 2). None of the B.t. formulations had a significant effect on 1st instar larvae when compared to the control. This was deemed to be the result of a torrential rain which started falling soon after the sprays had been applied. It is obvious from looking at graph 2 that all foliar treatments including the Ambush were affected by the downpour. The numbers of 2nd, 3rd and 4th instar larvae were, by comparison, significantly reduced by the Thimet 15G, Ambush and B.t. treatments alike.

A third count was conducted on July 17 and July 18 approximately five days after the application of the third spray. The numbers of 1st instar larvae were significantly reduced only in the Thimet 15G, Ambush and MYX 9858 treatments.

Similarly, the numbers of 2nd and 3rd instar larvae were effectively reduced (Graph 3, Table 3) by the Thimet 15 G, Ambush and MYX 9858 treatment while the M-ONE and MYX 1806 treatments provided some control. The numbers of the 4th instar larvae were reduced by the Thimet 15 G, Ambush and B.t. treatments alike.

Although a spray was applied on July 20, no further counts were conducted thereafter. Larvae were first seen dropping to the ground to pupate on July 19. Data collected at harvest indicated (Graph 4, Table 4) that total yields in all treatments were significantly improved when compared with the control. The best treatment was Ambush which was significantly better than the Thimet 15 G and the B.t. formulations with the exception of MYX 9858.

It was noteworthy in this experiment that all the B.t. plots had suffered some late season damage by potato flea beetles.

CONCLUSION

It appears from the preceeding results that all B.t. products, when compared to the control, were useful in diminishing potato beetle larvae populations and preventing drastic reductions in yield. Their use in conjuction with the use of chemical insecticides must be investigated in the future.

GRAPH #1

B.T TRIAL 1989
JUNE 27 COUNTS

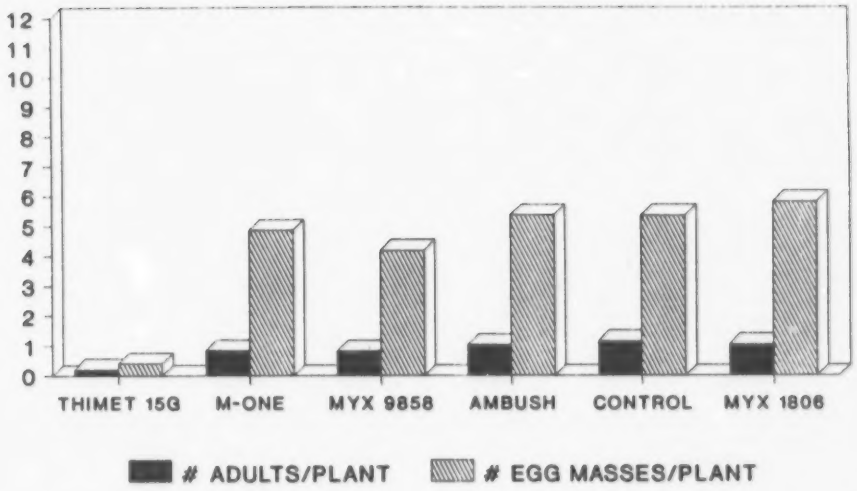


TABLE #1

JUNE 27TH COUNTS

	# ADULTS/PLANT *	# EGG MASSES/PLANT *
THIMET 15G	0.21 b	0.41 b
M-ONE	0.83 a	4.85 a
MYX 9858	0.81 a	4.17 a
AMBUSH	1.02 a	5.35 a
CONTROL	1.14 a	5.34 a
MYX 1806	1.03 a	5.80 a

* Indicates significance at .05 level.

GRAPH #2

B.T TRIAL 1989
July 5,6,7 COUNTS

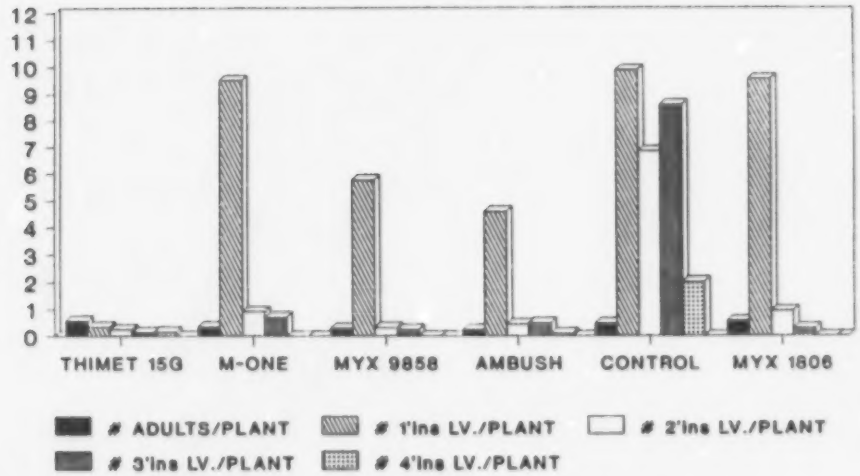


TABLE #2

JULY 5th, 6th, 7th COUNTS

	# ADULTS/PLANT *	# LARVAE/PLANT *	
		# 1 INSTAR	# 2 INSTAR
THIMET 15G	0.57 a	0.34 c	0.25 b
M-ONE	0.34 ab	9.50 a	0.91 b
MYX 9858	0.29 ab	5.76 ab	0.32 b
AMBUSH	0.24 b	4.59 bc	0.44 b
CONTROL	0.47 ab	9.87 a	6.85 a
MYX 1806	0.56 a	9.54 a	0.93 b

	# 3 INSTAR	# 4 INSTAR
THIMET 15G	0.14 b	0.16 b
M-ONE	0.69 b	0.00 b
MYX 9858	0.24 b	0.00 b
AMBUSH	0.48 b	0.10 b
CONTROL	8.57 a	1.99 a
MYX 1806	0.28 b	0.00 b

* Indicates significance at .05 level.

GRAPH #3

B.T TRIAL 1989
July 17,18 COUNTS

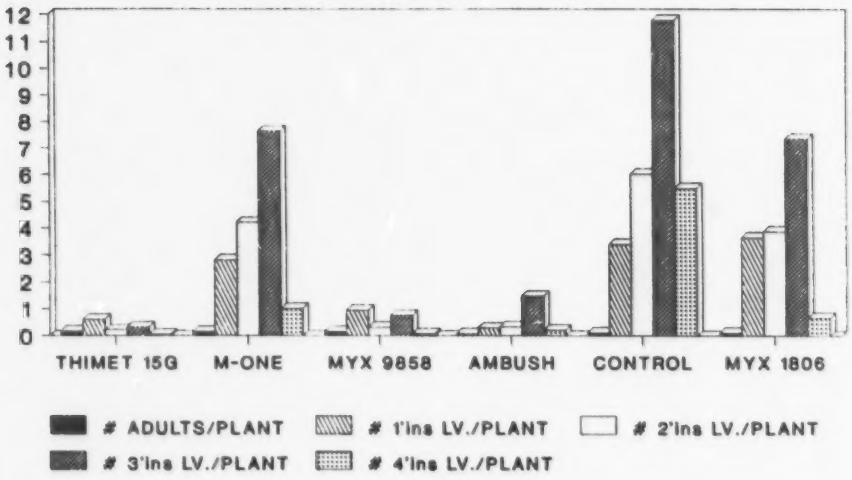


TABLE #3

JULY 17th-18th COUNTS

	# ADULTS/PLANT (n.s.)	# LARVAE/PLANT *	
		1st INSTAR	2nd INSTAR
THIMET 15G	0.17	0.61 b	0.23 c
M-ONE	0.16	2.80 a	4.20 b
MYX 9858	0.16	0.95 b	0.32 c
AMBUSH	0.07	0.29 b	0.35 c
CONTROL	0.11	3.39 a	6.02 a
MYX 1806	0.11	3.63 a	3.86 b

	3rd INSTAR	4th INSTAR
THIMET 15G	0.32 c	0.05 b
M-ONE	7.62 b	1.01 b
MYX 9858	0.75 c	0.07 b
AMBUSH	1.47 c	0.21 b
CONTROL	11.78 a	5.47 a
MYX 1806	7.33 b	0.68 b

* Indicates significance at .05 level.

GRAPH #4

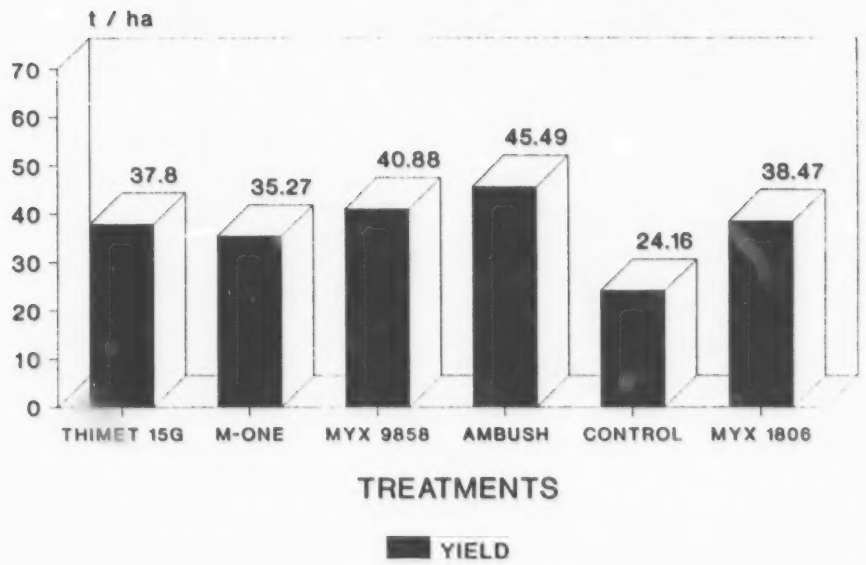


TABLE #4

TOTAL YIELD *

THIMET 15G	37.8 b
M-ONE	35.27 b
MYX 9858	40.88 ab
AMBUSH	45.49 a
CONTROL	24.16 c
MYX 1806	38.47 b

* Indicates significance at .05 level.

EFFECT OF TOPKILL DATE ON YIELD OF DESIRÉE CULTIVAR SEED POTATOES

R.P. Hinds and A.F. PERLEY

ABSTRACT: As part of the ongoing efforts to develop a management profile for the potato cultivar Desirée, three topkill dates were imposed upon the crop - an early date, August 8, a medium date, August 25 and a late date, August 30 (mandatory date). Total yield was significantly reduced (24-46%) by the early topkill date compared to the later dates. The later topkill dates produced significantly higher yields of large tubers and marketable tubers in the size range 30-60 mm. There were no significant differences in total yield and yield in the size range 30-60 mm between the medium and the late topkill dates. Scab incidence was significantly higher in the later topkill dates over the early date. This was due not to greater infection but from an enlargement of lesions as the tuber matured and expanded.

EFFET DE LA DATE DE DÉFANAGE SUR LE RENDEMENT DU CULTIVAR DE POMMES DE TERRE DE SEMENCE DESIRÉE

Résumé: Dans le cadre des tentatives faites actuellement en vue de dresser un profil de gestion pour le cultivar de pommes de terre de semence Desirée, on a établi trois dates pour le défanage de la récolte: une date précoce (8 août), une date intermédiaire (25 août) et une date ultime (30 août). Le rendement total était beaucoup réduit (de 24 à 46 %) par le défanage hâtif, comparativement au défanage fait aux dates ultérieures. Le défanage aux dates plus tardives a produit des rendements plus élevés de gros tubercules et de tubercules commercialisables ayant un diamètre de 30 à 60 mm. Aucune différence importante n'a été notée dans le rendement total et le rendement de tubercules ayant un diamètre de 30 à 60 mm pour ce qui est de la date intermédiaire et la date ultime de défanage. Le taux de gale était beaucoup plus grand dans les pommes de terre défanées aux deux dernières dates que dans celles défanées plus tôt. Ce phénomène n'est pas attribuable à une infection plus grave, mais plutôt à l'agrandissement des lésions à mesure que les tubercules mûrissaient et grossissaient.

INTRODUCTION: The recent introductions of yellow-flesh foreign potato cultivars in the New Brunswick system, have created the need to establish management profiles for these new cultivars. Factors which affect yield and quality such as nitrogen rates, intra-row spacings, whole versus cut seed, length of growing season, topkill dates, etc., must be investigated in order to provide producers with the technology required to grow these new varieties and be competitive. Desirée is a Dutch introduction being grown for the Cuban market, which requires tubers in the size range 35-55 mm. This experiment was designed to examine the effects of topkill date on the size distribution of yield of Desirée seed for the Cuban market.

METHOD: The experiment was a RCBD with four replicates (blocks).
Treatments were:
Topkill Date of August 18.
Topkill Date of August 25.
Topkill Date of August 30 - Mandatory.
Topkill date set by the industry.

Cut seed (60g in weight) was planted on June 1, 1989 with 135 kg/ha of N, P_2O_5 and K_2O applied by placement at planting.

Inter-row spacing was 91 cm and intra-row spacing was 30 cm. Plot size was 195 m^2. Rotation practice was potatoes, grain, potatoes, winter rye, potatoes. Soil testing was done prior to planting. July was a particularly dry month as rainfall was only 60% of normal.

RESULTS AND DISCUSSION: Yield: Table 1 shows the effect of topkill date on yield of the various sizes of Desirée seed. The medium and late topkill dates produced significantly higher total yield than the early topkill date. The difference in total yield is so large that a producer would stand to lose between 24-46% of his yield by killing the crop too early. The medium topkill date while not significantly different from the late topkill date, was in fact 10% less in total yield. Yield in the size range > 60 mm is not required by the Cuban trade and is difficult to market. These were all significantly different from each other. The early topkill date produced less tonnage of larger tubers than the other topkill dates. The later the topkill date, the greater was the tonnage of larger tubers. Yield in the size range 30-60 mm required by the trade for the Cuban market was significantly better (29%) in the medium and later topkill dates than the early one. There was no significant difference in yield of 30-60 mm size for the medium and late dates. Nor were there any significant differences in yield of tubers <30mm between the topkill dates.

TABLE 1: YIELD OF DESIRÉE SEED POTATO CULTIVAR AS AFFECTED BY DATE OF TOPKILL

Treatment	Yield t/ha			
	<30 mm	30-60 mm	>60 mm	Total
1. Aug.18-Topkill Date - Early	3.50^A	19.28^B	1.04^C	23.82^B
2. Aug.25-Topkill Date - Medium	3.05^A	25.00^A	3.06^B	31.71^A
3. Aug.30-Topkill Date - Late (Mandatory Date)	3.96^A	25.40^A	5.60^A	34.96^A

Duncan's Multiple Range Test - 0.05 level. Means with the same letter are not significantly different from each other.

Scab Incidence: Desirée is a scab susceptible cultivar and the field selected has a ten year history of scab. Scab incidence observed is shown in Table 2. No tuber had more than 1% of surface covered with scab. The later topkill dates produced a significantly higher yield of tubers with no visible scab lesions than the early topkill date as well as a higher yield of tubers with scab. There was no significant difference between the medium and late topkill date in relation to zero scab incidence. These differences in scab incidence are due, not to a greater infection on the larger tubers, but to enlargement and greater definition of the lesions as the tuber expands. The early topkill date produced 11% of the total yield with scab lesions versus 23% and 28% for the medium and late topkill dates.

TABLE 2: EFFECT OF TOPKILL DATE ON SCAB INCIDENCE IN DESIRÉE SEED POTATO CULTIVAR

Treatment	Yield t/ha Tuber area% covered with scab lesions 0%	<1%
Aug.18 Topkill Date-Early	21.51^{B}	2.31^{B} (*11%)
Aug.25 Topkill Date-Medium	25.75^{AB}	5.93^{A} (23%)
Aug.30 Topkill Date-Late	27.32^{A}	7.64^{A} (28%)

Duncan's Multiple Range Test - 0.05 level. Means with the same letter are not significantly different from each other in each class.

* Represents % of total yield.

Soil Analysis: Mean soil analysis for the main plots prior to planting indicates close similarity between plots and any differences seen in yield between the treatments can be attributed to the treatment themselves and not to soil fertility differences (Table 3).

TABLE 3: MEAN SOIL ANALYSIS RESULTS OF PLOTS PRIOR TO PLANTING - HOLMESVILLE CLAY LOAM SOIL SERIES

Treatment	pH	kg/ha P_2O_5	kg/ha K_2O	kg/ha Ca	kg/ha Mg	O.M. %
1. Aug.18-Topkill Date Early	5.7	513+	359	1626	213	3.2
2. Aug.25-Topkill Date Medium	5.5	513+	430	1757	240	3.3
3. Aug.30-Topkill Date	5.8	513+	430	1359	178	3.2

CONCLUSION: Early topkilling of the Desirée potato cultivar for seed greatly reduced the total yield and marketable yield in the size range 30-60 mm. Yield reduction varied between 24-46% for the early versus the later dates. Later topkilling resulted in a higher percentage of large tubers and a higher yield of tubers with scab. The latter was the result of enlargement and greater definition of the scab lesions on the larger tubers as they expanded rather than from a higher infection level.

ACKNOWLEDGEMENT: The authors respectfully acknowledge the efforts of G.P. Coté during the period the work was undertaken.

EFFECT OF GYPSUM ON YIELD AND SCAB INCIDENCE IN THE POTATO CULTIVAR KENNEBEC

R.P. Hinds and A.F. Perley

ABSTRACT: Kennebec potato cultivar (scab-susceptible) was planted on the Holmesville soil series (pH 5.0) naturally infested with common scab (Streptomyces scabies). Plots were top-dressed, post-planting with 0, 336, 672, 1008 kg/ha of gypsum in an RCBD. Total yield was unaffected by gypsum. However, the 672 kg/ha treatment produced better yields of tubers in the size range >60mm compared to other treatments and significantly so over the 336 kg/ha treatment. Though not significant, gypsum reduced scab incidence but no relationship was observed between scab reduction and a lowering of periderm tuber %Ca. Tuber periderm %Ca was the same in all treatments, due in part to the periderm removal method and sample amount for analysis. Leaflet %Ca was also unaffected by the treatments. Gypsum increased Ca levels in the soil by ½ to 50% in the highest gypsum treated plots compared to the control. Specific gravity and french fry color was unaffected by the treatments though sucrose levels were higher in all the gypsum plots though not to the extent to be detrimental to fry color.

EFFET DU GYPSE SUR LE RENDEMENT DU CULTIVAR DE POMMES DE TERRE KENNEBEC ET SUR LA FRÉQUENCE DES CAS DE GALE

Résumé: Des cultivars de pommes de terre Kennebec (sensibles à la gale) ont été plantés dans des sols de type Holmesville (pH de 5) naturellement infestés par la gale commune (Streptomyces scabies). On a répandu du gypse sur les parcelles d'essai d'un dispositif expérimental en bloc divisé au hasard à raison de 0, 336, 672 et 1 008 kg/ha après la plantation. Le rendement total n'a pas varié avec le gypse. Toutefois, les parcelles traitées à raison de 672 kg/ha ont produit plus de tubercules mesurant >60 mm de diamètre que les parcelles soumises aux autres traitements, principalement celles ayant reçu une dose de 336 kg de gypse à l'hectare. On a noté une réduction peu importante de la fréquence des cas de gale, mais l'on n'a pu établir de rapport entre la réduction de la gale et la diminution du taux de calcium dans la pelure des tubercules. La teneur en calcium de la pelure était uniforme pour tous les traitements, en partie à cause de la méthode utilisée pour prélever la pelure et de la quantité de pelure analysée. Le taux de calcium dans les feuilles n'a pas été modifié par les traitements. Le gypse a eu pour effet d'augmenter jusqu'à 50 % le taux de calcium dans le sol des parcelles traitées avec les plus fortes doses de gypse, comparativement aux parcelles témoins. La densité relative et la couleur des frites n'ont pas été modifiées par les traitements et, même si le taux de sucrose était plus élevé dans toutes les parcelles traitées au gypse, il ne l'était pas assez pour modifier la couleur des frites.

METHOD: Plots on the Holmesville clay loam soil series with a known history of scab were selected for the study. The soil tested low for Ca level (800-1000 kg/ha - Ca) under NB standards. pH levels ranged from 5.0-5.4 at time of planting. Cut seed of Kennebec was used. Intra-row spacing was 20 cm and inter-row spacing was 90 cm.

Gypsum was applied topdressed prior to any cultivations at the rate of 0, 336, 672 and 1008 kg/ha. Cultivations and hilling allowed the gypsum to remain in the hill where the tubers were to develop.

An RCBD was employed.

Soil analyses were done prior to planting and at 8 weeks post-planting - the latter being the period of tuber initiation and early tuber development. Tuber periderm %Ca was determined by peeling the tubers with a carrot peeler and analyzing the peel.

Plot size was 55.8m^2. Gypsum used contained 22% Ca and 16% S. Scab ratings were done on the basis of the key (Can. Plant Dis. Surv. 51: 1971).

Conditions during the period of tuber initiation and development were highly conducive to scab development as moisture was limiting as a result of a drought during July, when rainfall was 50% of normal.

The crop was harvested September 12, 1989.

RESULTS: Soil Analyses: Mean soil analysis results for the treatments are given in Table 1. The soil was acid and tested low for Ca. Hinds and Ghanem (1983) in previous work found that pH had little effect on scab incidence as infection occurred at low, medium and high pH. Gypsum has clearly increased Ca level of the soil (up to 50% higher at the highest gypsum level) and is an excellent source of Ca. This was an ideal soil to test for scab incidence with a scab-susceptible cultivar like Kennebec.

TABLE 1: MEAN SOIL ANALYSIS AT FOUR LEVELS OF GYPSUM APPLICATION ON KENNEBEC POTATO CULTIVAR - 8 WEEKS POST GYPSUM APPLICATION

TREATMENT	Soil Analysis*					
	pH	O.M. %	P_2O_5 kg/ha	K_2O kg/ha	Ca kg/ha	Mg kg/ha
1. 0 kg/ha Gypsum	5.5	3.2	513+	368	881	110
	(4.8)	**(2.8)**	**(513+)**	**(430+)**	**(596)**	**(62)**
2. 336 kg/ha Gypsum	5.4	3.3	513+	276	952	101
	(5.0)	**(3.3)**	**(513+)**	**(430+)**	**(901)**	**(118)**
3. 672 kg/ha Gypsum	5.5	2.9	513+	323	1146	116
	(5.1)	**(3.2)**	**(513+)**	**(430+)**	**(894)**	**(102)**
4. 1008 kg/ha Gypsum	5.5	3.4	513+	283	1331	104
	(5.1)	**(3.1)**	**(513+)**	**(430+)**	**(853)**	**(105)**

* **Bracketed figures are values pre-planting.**

YIELD: Table 2 shows yield data for gypsum treated plots. There were no differences in total yield between the control and the gypsum treatments. The 672 kg/ha gypsum treatments produced a higher yield of tubers >60mm in size than all the other treatments but was significantly better than the 336 kg/ha treated plot. These oversize (>60mm in size) tubers of Kennebec are

usually sold at a premium price. As in the previous study with Shepody 672 kg/ha gypsum appears to be about the minimum to be applied.

TABLE 2: YIELD OF KENNEBEC AS AFFECTED BY FOUR LEVELS OF GYPSUM

TREATMENT	Yield t/ha			
	<30mm	30-60mm	>60mm	TOTAL
1. 0 kg/ha Gypsum	1.83^{A}	24.60^{A}	11.18^{AB}	37.60^{A}
2. 336 kg/ha Gypsum	2.44^{A}	25.82^{A}	8.94^{B}	37.20^{A}
3. 672 kg/ha Gypsum	1.83^{A}	21.75^{A}	14.03^{A}	37.60^{A}
4. 1008 kg/ha Gypsum	1.83^{A}	24.19^{A}	12.50^{AB}	38.52^{A}

Duncan's Multiple Range Test - 0.05 level. Means with the same letter are not significantly different from each other.

Scab Incidence and Tuber Periderm Ca%: Table 3 shows data on scab incidence and tuber periderm %Ca in Kennebec as affected by four levels of gypsum. All gypsum treatments produced a higher yield of potatoes with little or no scab and a correspondingly smaller yield of tubers with high levels of scab than the control. Gypsum has been beneficial in scab reduction, and earlier skin development in gypsum treated plots compared to the control, was observed. A lower %Ca in the periderm associated with scab reduction as suggested by Davis et al (1976) was not observed. Tuber %Ca was virtually the same in all the treatments, due in part to the method of removal of the periderm and sample amount for analysis. Leaflet %Ca seems to have been unaffected by gypsum application (Table 4) as was shown by Simmons and Kelling (1987).

TABLE 3: SCAB INCIDENCE AND TUBER PERIDERM % CA IN KENNEBEC AS AFFECTED BY FOUR LEVELS OF GYPSUM

TREATMENT	TUBER % Ca	YIELD t/ha TUBER % COVERED WITH SCAB LESIONS 0 - 10%	> 10%*
1. 0 kg/ha Gypsum	0.01	34.87[A]	2.74[A] (7.3%)
2. 336 kg/ha Gypsum	0.01	36.35[A]	0.85[A] (2.3%)
3. 672 kg/ha Gypsum	0.01	36.26[A]	1.35[A] (3.6%)
4. 1008 kg/ha Gypsum	0.02	36.30[A]	2.20[A] (5.7%)

Duncan's Multiple Range Test 0 0.05 level. Means with the same letter are not significantly different from each other in the same group.

* Not acceptable by the Trade. Figures in brackets represent % of total yield.

TABLE 4: MEAN LEAF AND TUBER PERIDERM ANALYSES OF SHEPODY POTATO CULTIVAR AS AFFECTED BY FOUR LEVELS OF GYPSUM

TREATMENT	PLANT PART TESTED	N	% P	K	Ca	Mg	ppm Zn	B	Cu	Mn	Fe
1. 0 kg/ha Gypsum	Leaf*	6.05	0.49	3.07	0.70	0.44	33	17	24	90	93
	Tuber Periderm	1.38	0.23	2.28	0.01	0.07	15	7	8	7	212
2. 336 kg/ha Gypsum	Leaf	6.04	0.51	2.96	0.65	0.42	34	17	23	76	90
	Tuber Periderm	1.44	2.24	2.45	0.01	0.08	15	7	8	8	225
3. 672 kg/ha Gypsum	Leaf	6.10	0.52	2.71	0.63	0.40	41	15	22	83	82
	Tuber Periderm	1.46	0.24	2.45	0.01	0.07	15	6	9	7	179
4. 1008 kg/ha Gypsum	Leaf	6.00	0.52	2.60	0.65	0.43	42	14	22	83	87
	Tuber Periderm	1.55	0.25	2.37	0.02	0.08	15	6	9	8	224

* Mid-season for leaf and petiole and tuber periderm at harvest.

Specific Gravity, French Fry color and Sucrose Content: Gypsum treatments had no significant effect upon specific gravity and french fry color in Kennebec (Table 5). Gypsum treatments did produce a slightly higher sucrose content and the 336 kg/ha treatment was significantly higher than the control. These values, however, did not affect french fry color of the crop out of the field. This is a seed crop where color is not a factor, but were it for processing, careful attention would have been needed if the crop was to be stored for a protracted period prior to processing.

TABLE 5: MEAN TUBER SPECIFIC GRAVITY, FRENCH FRY COLOR AND SUCROSE CONTENT OF KENNEBEC AS AFFECTED BY FOUR LEVELS OF GYPSUM

TREATMENT	MEAN TUBER SPECIFIC GRAVITY	MEAN FRENCH FRY COLOR-MEAN U.S.D.A. EQUIVALENT*	MEAN SUCROSE CONTENT - mg/g
1. 0 kg/ha Gypsum	1.068	**1.0**	1.10^{B}
2. 336 kg/ha Gypsum	1.064	**1.1**	1.89^{A}
3. 672 kg/ha Gypsum	1.066	**1.1**	1.33^{AB}
4. 1008 kg/ha Gypsum	1.065	**1.0**	1.61^{AB}

* U.S.D.A. color of 1-4 is acceptable for french fry trade. Higher numbers correspond to worsening of color.

CONCLUSIONS: Total yield was unaffected by gypsum application but yield of tubers >60mm in size was higher in gypsum plots, with the 672 kg/ha plots being significantly better than the 336 kg/ha gypsum application. In Kennebec, oversize tubers generally carry a premium price in some market niches. Gypsum resulted in a reduction in scab incidence compared to the control but no relationship to periderm tuber %Ca was observed. Leaflet %Ca was unaffected by application of gypsum. Specific gravity and french fry color was unaffected by gypsum but sucrose content was higher under gypsum than the control, though this did not affect french fry color.

Gypsum increased soil Ca levels by up to 50% at the highest level 1008 kg/ha over the control.

ACKNOWLEDGEMENTS: The authors respectfully acknowledge the efforts of B. Jepperson during the period the work was undertaken.

REFERENCES:

1. Davis, J.R., McDole, R.E., and R.M. Callihan. 1976. Fertilizer effects on common scab of potato and the relation of calcium and phosphate - phosphorus. Phytopathology 66: 1236-1241.

2. Hinds, R.P., and I. Ghanem. 1983. Limestone and gypsum applications on potatoes. Pot. Prod. Rep. Pot. Div. NBDA.

3. Kellman, A., McGuire, R.G., and K.C. Tzeng. 1989 in Management of Diseases by Micro and Macroelements, Engelhard, A.W. ed. pp.102-123.

4. Simmonds, K.F., and K.A. Kelling. 1987. Potato Responses to Calcium Application on Several Soil Types. Am. Pot. J. 64: 119-136.

GREEN MANURE - GYPSUM EFFECTS ON YIELD AND SCAB INCIDENCE IN THE POTATO CULTIVAR SHEPODY

R.P. HINDS AND A.F. PERLEY

ABSTRACT: Several green manure strips were established in 1989 at two locations on the Holmesville clay loam soil series with a history of common scab caused by streptomyces scabies. The strips were chopped and plowed down in the fall. Imposed on the strips in a split plot design in 1991 will be 4 levels of gypsum: 0, 672, 1344 and 2016 kg/ha, to investigate the effects of gypsum on yield and scab incidence in the scab-susceptible potato cultivar Shepody, in the absence of irrigation. This study is intended to develop in the absence of appropriate varietal resistance, an integrated disease management program, that is an effective way to achieve adequate disease reduction under N.B. conditions.

EFFET DE L'ENGRAIS VERT ET DU GYPSE SUR LE RENDEMENT DES CULTIVARS DE POMMES DE TERRE SHEPODY ET SUR LA FRÉQUENCE DES CAS DE GALE

Résumé: De l'engrais vert a été semé en 1989 sur plusieurs bandes de terrain à deux endroits dans des sols de type Holmesville formés de loam argileux, qui sont habituellement infestés par la gale commune causée par les Streptomyces scabies. Les cultures ont été coupées et enfouies dans le sol à l'automne. En 1991, on appliquera du gypse sur les bandes selon un dispositif expérimental à raison de 0, 672, 1 344 et 2 016 kg/ha, afin d'étudier l'effet du gypse sur le rendement et sur la fréquence des cas de gale dans le cultivar de pommes de terre Shepody qui est sensible à cette maladie. Aucune irrigation ne sera faite. L'étude, qui est réalisée en l'absence d'une résistance variétale appropriée, a pour but de mettre au point un programme complet de lutte contre la maladie et représente un moyen efficace de réduire suffisamment la fréquence de la maladie dans les conditions qui prévalent au Nouveau-Brunswick.

METHOD: Strips of green manure crops were established as shown in Figures 1 and 2 at two locations on the Holmesville clay loam soil series, naturally infested with the common scab, Streptomyces scabies. Fertilizer at the rate of 336 kg/ha of a blended 19-9-18 was applied at the time of planting on all treatments. Planting was completed on June 6 at one location and June 5 at another.

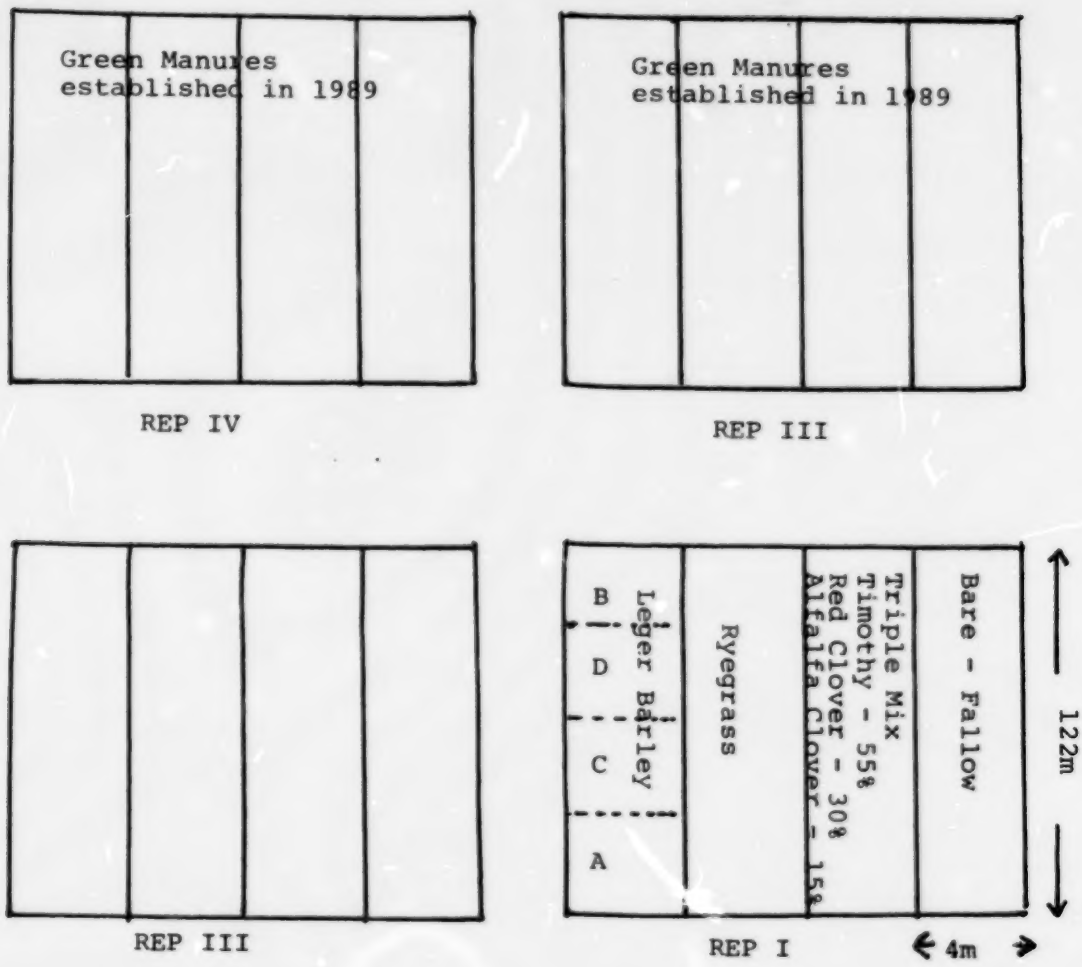
The strips were chopped on August 10, and fall plowed. Dry matter additions to the soil prior to chopping was estimated by random selection of 3 foot square portions of vegetation. Shepody potato cultivar (scab-susceptible) will be planted in 1990 on all strips and gypsum at the rate of 0, 672, 1344 and 2016 kg/ha will be imposed upon each strip in a split plot design. Data to be collected over the next three years include:

- O.M. %
- Dry matter incorporated
- Moisture required during growth
- Soil and petiole analyses
- Scab incidence (tuber area % covered with lesions)
- Hollow heart
- Yield (quantity and quality)
- Tuber periderm % Ca
- Specific gravity, sucrose and french fry color

RESULTS: Results will be reported between 1990-1991.

LOCATION I

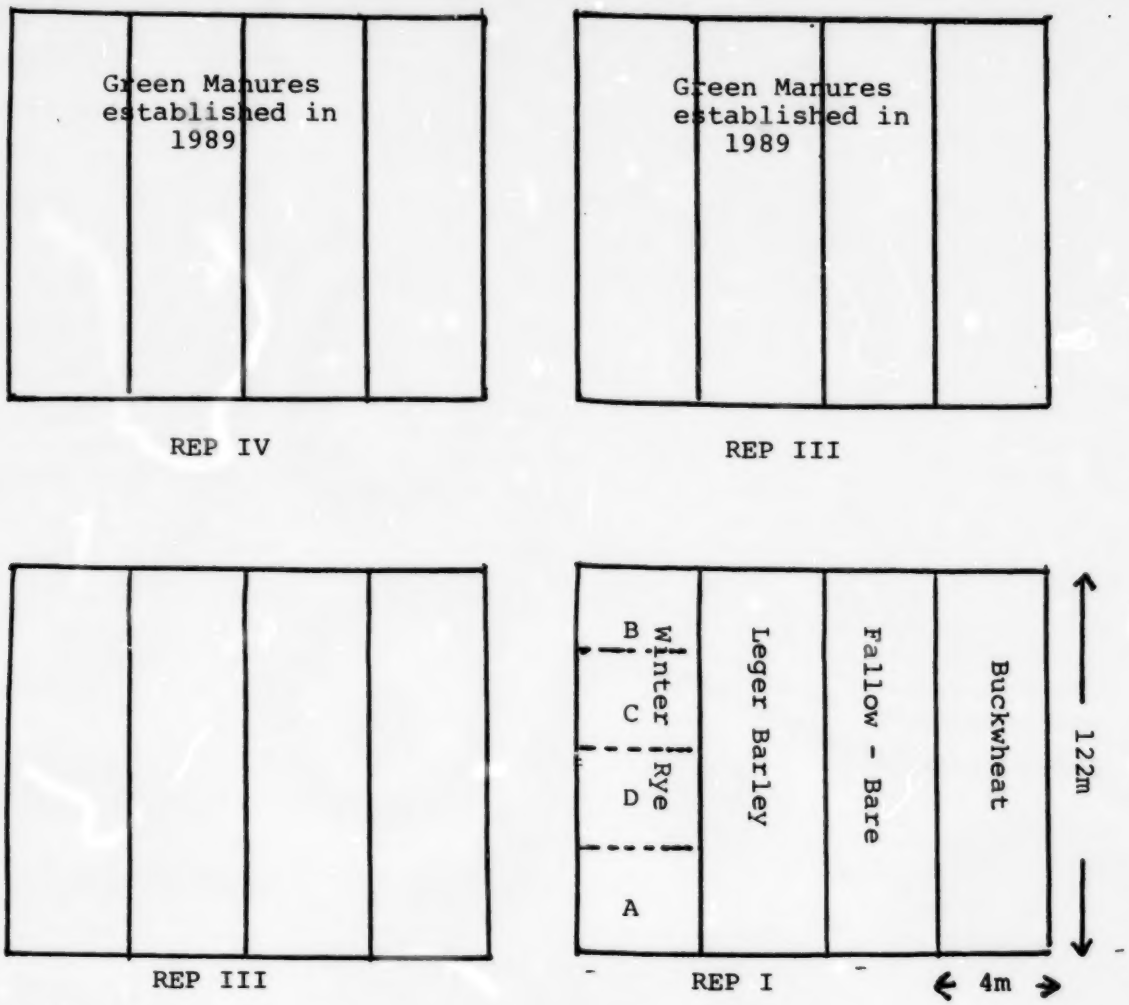
Green Manure/Gypsum Effects on yield and Scab Incidence in Shepody Potato Cultivar - Holmesville Soil Series
Split Plot Design - Four replications



A - 0 kg/ha Gypsum]
B - 672 kg/ha Gypsum] to be applied
C - 1344 kg/ha Gypsum] in 1990
D - 2016 kg/ha Gypsum]

LOCATION II

Green Manure/Gypsum Effects on Yield and Scab Incidence in the Potato Cultivar Shepody.
Holmesville Soil Series - Location II
Split Plot Design - Four Replications



A - 0 kg/ha Gypsum]
B - 672 kg/ha Gypsum] to be applied
C - 1344 kg/ha Gypsum] in 1990
D - 2016 kg/ha Gypsum]

FIELD OBSERVATIONS ON THE RUMPTSTAD FOUR-ROW RIDGE SHAPER VERSUS CONVENTIONAL HILLING IN THE PRODUCTION OF RUSSET BURBANK POTATO CULTIVAR

R. P. Hinds

ABSTRACT: Field observations on the production of Russet Burbank potato cultivar using a Rumptstad 4-row ridger versus conventional hilling, were determined on the Caribou Clay loam soil series. The Rumptstad ridger buried the seed pieces under 15 cm of soil. Emergence was delayed, growth was reduced and weed control was poor under the Rumptstad ridges. There was a 35% decrease in total yield under the Rumptstad ridges which also produced a greater percentage of off-type and oversize tubers. Marketable yield under the Rumptstad ridges was 26.81 t/ha versus 45.47 t/ha under conventional hilling. Conventional hilling produced better quality potatoes in terms of both specific gravity and french fry color.

OBSERVATIONS SUR L'UTILISATION D'UNE CHARRUE BUTTEUSE RUMPTSTAD À 4 BUTTEURS ET D'UNE MÉTHODE CONVENTIONNELLE DE BUTTAGE POUR LA PRODUCTION DE CULTIVARS DE POMMES DE TERRE RUSSET BURBANK

Résumé: Des observations au champ relatives à la production de cultivars de pommes de terre Russet Burbank ont été faites dans des sols de type Caribou formés de loam argileux pour comparer l'utilisation d'une charrue butteuse Rumptstad à quatre butteurs par rapport à une méthode conventionnelle de buttage. Avec la charrue butteuse Rumptstad, les morceaux de semence étaient enterrés sous 15 cm de terre. La levée fut retardée, la croissance fut réduite et la répression des mauvaises herbes n'a pas été bonne sur les parcelles buttées avec la Rumptstad. On a noté que cette machine avait entrainé une baisse de 35 % du rendement total et une augmention de la proportion des pommes de terre hors type et des pommes de terre trop grosses. Le rendement de pommes de terre commercialisables était de 26,81 t/ha avec la Rumptstad et de 45,47 t/ha avec la méthode conventionnelle de buttage. Le buttage conventionnel a produit des pommes de terre de meilleure qualité en termes de densité relative et de couleur des frites.

INTRODUCTION: Over the years, potato production in N.B. in general, incorporated at least one cultivation and two hilling operations to effect the width and height of hills considered necessary for tuber development. Technologies from other potato growing areas, have been evaluated in the past with varying success, but in recent years the Rumptstad Ridge shaper from Holland has received serious consideration. The Rumptstad 4-row ridge shaper retails for about $20,000 (Can.) and reports from potato growers have indicated that the ridger can work in shallow soils, and is ideal for cloddy soils. Because of the need for P.T.O. attachment, the operation of ridging is slow and reports of yields vary from less than average to average over the past two years. N.B. potato soils are stony and where there are excessive stones, operation of the ridges becomes difficult. As a consequence of the foregoing, it was decided to examine the use of the equipment on a very good potato farm on a field scale up to 20 acres compared to conventional hilling methods for the crops.

EQUIPMENT AND METHODS: The Rumptstad 4-row ridger used, effectively made 4 rows, 36 inches (91.5 cm) apart (Figure 1). The ridgers are adjustable in both the

horizontal and vertical directions. Three complete ridgers are used with two halves on the outside creating 4 completed ridges. The equipment is P.T.O.

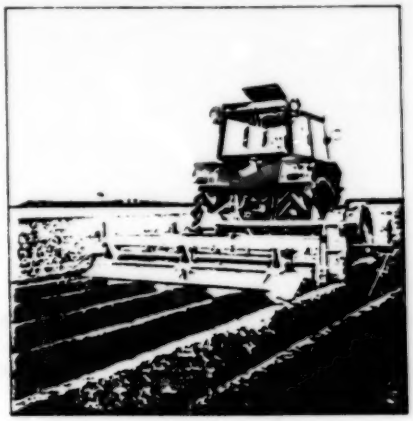


Figure 1: Ridge Shaping

driven and adjustments in height are made by means of a screw-type adjuster. Conventional hilling equipment consists of a tool bar with tines in front and ridgers at the back which allow for 2 complete ridges in the center and 2 half-ridges on the outside which are completed in the next run. Conventional hilling equipment is center mounted or rear-mounted but not P.T.O. driven.

Two fields on the Caribou clay loam soils series were treated. The rotation sequence for the fields was potatoes, grain (underseeded to clover). Clover was kept for one full year.

After planting and weed control with Metribuzin (standard treatment), 20 acres of Russet Burbank potato cultivar were ridged with the Rumptstad 4-row ridger. Twenty acres were left and cultivated and hilled in the conventional manner prior to full bloom.

The crop was planted on May 20th and harvested on Oct. 14, 1989. Tuberisation occurred around July 4, 1989. Hilling was completed by June 30, 1989. Rainfall in July was 50% of normal. Fertilizer was 1120 kg/ha 15-15-15.

RESULTS: Emergence and Growth: Emergence was 8-10 days later under the Rumptstad 4-row ridges, which had buried the seed pieces under 6 inches (15 cm) of soil. In addition, the young plants emerged everywhere on the hill. Some plants came through the left side, some through the top and some through the right side of the hill. It looked an awful mess. The grower's mental anguish was compounded when the Rumptstad ridged field was overrun with weeds - Lamb's Quarters (Chenopodium

album L.). Leger barley and Lady's Thumb (Polygonum persicaria L.).

This necessitated a second application of herbicide which failed to give complete control. As a result, the Rumptstad ridges were covered with weeds right up to harvest even after an attempt at mechanical cultivation. On July 25, 1989, an examination of hills was carried out to determine tuber number and size. Under the Rumptstad ridges, there were 6-8 tubers/hill with a mean diameter of 2.54 cm (1 inch). Under the conventional hills, there were 14-16 tubers/hill with a mean diameter of 5 cm (2 inches).

YIELD Table 1 shows the yields of the Rumptstad ridges versus conventional hilling. Conventional hilling produced total yields which were 35% greater than the Rumptstad ridges. The dense stand of weeds under the Rumptstad ridges would, from past experience, have accounted for at least 30% of the 38%, which means that conventional hilling produced a total yield which, had weeds been absent, would be 8% greater than the Rumptstad ridges. The Rumptstad ridges produced a greater tonnage of roughs and off type tubers as well as very large tubers (> 10 oz. or 283 g) than conventional hilling. Conventional hilling produced a greater yield of small tubers (< 3 ozs. or 84 g).

Marketable yield (3 - > 10 ozs. or 84 - > 283 g) under the Rumptstad was 26.81 t/ha versus 45.47 t/ha under conventional hilling.

TABLE 1: COMPARISON OF YIELDS OF THE RUMPSTAD 4-ROW RIDGE SHAPER VERSUS CONVENTIONAL HILLING IN RUSSET BURBANK POTATO CULTIVAR ON THE CARIBOU SOIL SERIES

Treatment		Yield t/ha				
		< 2 ozs. (< 56 g)	2-10 ozs. (56-283 g)	> 10 ozs. (> 283 g)	Off-Type	Total
1.	Rumptstad 4-row ridge shaper for hilling at planting	4.5	19.09	7.72	2.43	33.74
2.	Conventional Hilling Post Planting	9.0	41.41	4.06	0.0	54.47

Specific Gravity, French Fry Color and Sucrose Content: Table 2 shows a comparison of specific gravity, french fry color and sucrose content under the Rumptstad and conventional hilling. Conventional hilling produced tubers with a higher specific gravity and slightly better color than the Rumptstad ridges. Sucrose content was slightly better under the Rumptstad ridges than conventional hilling.

TABLE 2: COMPARISON OF SPECIFIC GRAVITY, FRENCH FRY COLOR AND SUCROSE CONTENTS OF THE RUMPSTAD 4-ROW RIDGE SHAPER VERSUS CONVENTIONAL HILLING IN RUSSET BURBANK POTATO CULTIVAR ON THE CARIBOU SOIL SERIES

	TREATMENT	Specific Gravity	French Fry * Color U.S.D.A. Equivalent	Sucrose Content mg/g
1.	Rumptstad 4-row Ridge shaper	1.072	1.4	0.82
2.	Conventional Hilling	1.083	1.2	1.06

U.S.D.A. color 1-4 is acceptable for french fry trade - Higher values indicate worsening of color.

CONCLUSION: Emergence was delayed and growth was reduced in Russet Burbank potato cultivar with the Rumptstad 4-row ridger compared with conventional hilling. Weed control was poor under the Rumptstad ridges. Tuber set and yield were also reduced under the Rumptstad ridges. Conventional hilling produced yields which were 38% greater with higher specific gravity and better french fry color than the Rumptstad ridges. Marketable yield was also greater under conventional hilling.

ACKNOWLEDGEMENT: The writer respectfully acknowledges the cooperation of H. Culberson during the period the work was undertaken and that of D. McIsaac for carrying out the sucrose, color and specific gravity analyses on tuber samples.

EFFECT OF GYPSUM ON YIELD AND SCAB INCIDENCE IN THE POTATO CULTIVAR SHEPODY

R.P. HINDS and A.F. PERLEY

ABSTRACT: Shepody potato cultivar (scab-susceptible) was planted on the Holmesville soil series (pH 6.1) naturally infested with common scab (Streptomyces scabies). Plots were top-dressed, post planting, with 0, 672, 1344 and 2016 kg/ha of gypsum in RCBD. Gypsum treatments increased total yield, with the 672 kg/ha treatment being significantly better than the control. Similarly all gypsum treatments reduced the incidence of scab with the 672 kg/ha treatment producing significantly higher yield of tubers with little or no scab (i.e. 0 - 10% of the tuber area covered with lesions) compared to the control. Gypsum treatments had only a very slight decrease in tuber periderm % Ca over the control. Gypsum had no significant effect upon specific gravity, french fry color, sucrose content, hollow heart, stem-end browning or leaf % Ca concentration. This work will continue for two more years.

EFFET DU GYPSE SUR LE RENDEMENT DU CULTIVAR DE POMMES DE TERRE SHEPODY ET SUR LA FRÉQUENCE DES CAS DE GALE

Résumé: Des cultivars de pomme de terre Shepody (sensibles à la gale) ont été plantés dans des sols de type Holmesville (pH de 6,1) naturellement infestés par la gale commune (Streptomyces scabies). On a répandu du gypse sur les parcelles d'essai d'un dispositif expérimental en bloc divisé au hasard à raison de 0, 672, 1 344 et 2 016 kg/ha après la plantation. Les traitements de gypse ont accru le rendement total, et les parcelles traitées avec 672 kg de gypse par hectare ont eu un rendement nettement supérieur à celui des parcelles témoins. De plus, tous les traitements de gypse ont contribué à réduire la fréquence des cas de gale, et les parcelles ayant reçu une dose de 672 kg/ha ont donné de biens meilleurs rendements de tubercules ayant peu ou pas de gale (c.-à-d. que les lésions galeuses couvraient 0 à 10 % du tubercule) que les parcelles témoins. Une très légère diminution du taux de calcium dans la pelure a été notée dans les parcelles ayant subi des traitements au gypse, comparativement aux parcelles témoins. Le gypse n'a pas eu d'effet important sur la densité relative, la couleur des frites, la teneur en sucrose, le coeur creux, le brunissement du talon ou sur la concentration de calcium dans les feuilles. Les essais se poursuivront pendant deux autres années.

INTRODUCTION: Common scab caused by a gram positive filamentous bacterium Streptomyces scabies is a ubiquitous, well adapted soil inhabitant, that reduces the quality of yield in susceptible potato cultivars. Anderson and Lorang (1988) reported that the disease can be minimized by crop rotations, irrigation, incorporation of green manures, the addition of sulphur in the form of gypsum or sulphur dust or by pentachloronitrobenzine (PCNB). Davis et al. (1976) hypothesized that the effects of various control measures which reduced scab could be explained by the resulting increase in Ca level of the potato plant but this has yet to be verified. Davis et al. (1974) demonstrated that both elemental S and gypsum reduced scab and soil pH when applied to soil, which had a pH of 7.7. However, they indicated that the reduction in soil pH was not sufficient to account for disease suppression. Ca levels in the tuber peelings were found to be lower than in the untreated plots, suggesting that the reduction of the disease was indirect and due to a decrease in Ca in the tuber peelings. Davis et al. (1976) subsequently indicated that the

concentration of Ca in the tuber periderm may be positively correlated with susceptibility to scab. These workers also noted that low soil moisture which increases scab, also resulted in higher Ca concentrations in tuber peelings. Kelman et al. (1989) reported that raising tuber Ca concentration reduces bacterial soft rot susceptibility in potatoes and it was reported that preplant strip application of sieved $CaSO_4$ was shown by other workers, to be one of the best Ca sources for improving tuber grade and quality. On the other hand, it was reported that lime was not an effective application for increasing Ca concentration in potato tubers and quality as sieved $CaSO_4$. Kelman et al. (1989) reported normal Ca in tuber periderm ranges from 0.057 - 0.277%. Simmons and Kelling (1987) found that on low Ca tested soils, gypsum did not affect total potato yield, but increased tuber grade and quality at rates of up to 1500 lbs. gypsum/Ac (300 kg Ca/ha). These improvements were accompanied by increased tuber periderm Ca concentrations, even though leaflet Ca concentrations were unaffected. On high Ca tested soils, responses were inconsistent, and tuber periderm Ca was generally not increased. Kelman et al. (1989) reported that tuber Ca concentration is strongly influenced by Ca concentrations in the hill surrounding the tuber as it develops, and direct movement of Ca into the tuber takes place from the soil either directly though the periderm, or though the stolon and tuber roots. It was found that sieved $CaSo_4$ applied (1500 lbs/ac) either broadcast, in a preplant strip or as a side-dress, were effective in increasing Ca concentration in the tuber. Consequent upon the foregoing, it was decided to examine the effects of gypsum ($CaSo_4 . 2H_20$) applied top-dressed post planting, upon scab incidence, yield and tuber periderm Ca concentration in Shepody, a scab susceptible potato cultivar, over a three year period.

METHOD: Plots on the Holmesville clay loam soil series with a 10-year history of scab were identified for the purpose of this three year study. The soil tested medium for Ca-levels (1200-2000 kg/ha) under NB Standards. Shepody (cut-seed) was planted on May 30th at 25 cm intra-row spacing. Gypsum was applied top-dressed at the rate of 0, 6572, 1344 and 2016 kg/ha. Cultivations and hilling allowed the gypsum to remain in the hill where the tubers were to develop. An RCBD was employed. Soil analyses were taken prior to and 8 weeks post planting in the latter being during the period of initiation and early tuber development. Plot size was 55.8 m^2. Gypsum used was 22% Ca and 16% S. Tuber periderm was rempved with a carrot peeler for analysis.

July, the month of tuber initiation and early development had 50% of normal rainfall. Conditions were highly

conducive to scab development. Scab was determined as per the key below (Can. Plant Dis. Surv. 51: 1971).

RESULTS: Soil Analysis: Mean soil analyses results for the treatments are given in Table 1. From a fertility status, the soil was ideal for growing potatoes under N.B. conditions.

TABLE 1: Mean Soil Analysis at Four Levels of Gypsum Application on Shepody Potato Cultivar - 8 weeks past Gypsum Application.

TREATMENT	Soil Analysis					
	pH	O.M. %	P_2O^5 kg/ha	K_2O kg/ha	Ca kg/ha	Mg kg/ha
1. 0 kg/ha gypsum	6.1	3.4	513+	374	1801	228
2. 672 kg/ha "	6.1	3.0	513+	361	1512	214
3. 1344 kg/ha "	6.1	3.5	513+	371	1844	230
4. 2016 kg/ha "	6.1	2.9	513+	427	1509	211

The soil tested medium for Ca and there are only minor soil differences between plots.

YIELD: Table 2 shows yield data for the four rates of gypsum application. All gypsum treatments produced a better total yield than where no gypsum was applied. The treatment with 672 kg/ha gypsum produced significantly better total yields than the control and produced equivalent yield to the higher rates of gypsum applications. There were no significant differences between yields of the various size classes.

TABLE 2: YIELD OF SHEPODY AS AFFECTED BY FOUR LEVELS OF GYPSUM

TREATMENT	Yield t/ha			
	<30mm	30-60mm	>60mm	Total
1. 0 kg/ha Gypsum	1.22^{A}	18.20^{A}	7.00^{A}	26.43^{B}
2. 672 kg/ha Gypsum	0.90^{A}	20.64^{A}	9.05^{A}	30.59^{A}
3. 1344 kg/ha Gypsum	1.06^{A}	18.04^{A}	9.56^{A}	28.66^{AB}
4. 2016 kg/ha Gypsum	1.01^{A}	16.98^{A}	10.78^{A}	28.77^{AB}

Duncan's Multiple Range Test - 0.05 level. Means with the same letter are not significantly different from each other.

Scab Incidence And Tuber Periderm Ca%: Table 3 gives the data on scab incidence and tuber periderm % Ca in Shepody as affected by four levels of gypsum. All gypsum treatments produced a higher yield of potatoes with little or no scab than the control. Plots treated with 672 kg/ha gypsum produced a significantly higher yield of tubers with little or no scab (0-10% tuber area covered with scab lesions) than the control. Differences between gypsum treatments and scab incidence were similar. An examination of treatments 5 weeks post-tuberisation showed that tubers under the gypsum treatments had a more advanced skin development than the control. It is felt that this earlier skin development may reduce ingress of the pathogen. It is well known that the susceptibility of the host is limited in time (tuber initiation to early tuber development). Keinath and Loria (1989) reported that infection only occurs as the stomates in the immature tubers are transformed into lenticels. Once the lenticels have matured and are completely suberised, the pathogen is unable to gain ingress. Gypsum may be hastening this transformation process. Tuber periderm Ca% was lower but not significantly so by the gypsum treatments. The method of removal of the periderm and sample amount for analysis

may have influenced readings observed. Simmons and Kelling (1987) reported that in higher soil test Ca soils, similar to the one in this trial, responses to gypsum were inconsistent and periderm Ca concentration was generally not increased. Leaflet Ca concentrations (Table 4) were unaffected by gypsum treatments as well. The highest leaflet Ca concentration was observed in the control plots.

TABLE 3: SCAB INCIDENCE AND TUBER PERIDERM % CA IN SHEPODY AS AFFECTED BY FOUR LEVELS OF GYPSUM APPLICATION

TREATMENT	TUBER PERIDERM %Ca	Yield t/ha TUBER AREA% COVERED WITH SCAB LESIONS 0 - 10%	> 10%*
1. 0 kg/ha Gypsum	0.07	26.30[B]	0.14
2. 672 kg/ha Gypsum	0.05	29.92[A]	0.67
3. 1344 kg/ha Gypsum	0.06	28.38[AB]	0.29
4. 2016 kg/ha Gypsum	0.06	28.70[AB]	0.07

Duncan's Multiple Range Test - 0.05 level. Means with the same letter are not significantly different from each other in the same group.
(* Not acceptable by the Trade).

Hollow Heart/Stem-End Browning: Neither stem-end browning nor hollow heart were affected by gypsum application (Table 5).

Specific Gravity, French Fry Color and Sucrose Content: Gypsum treatments had no significant effect upon specific gravity, french fry color or sucrose content (Table 6).

CONCLUSIONS: Gypsum produced a better total yield with the 672 kg/ha gypsum treatment producing a significantly better yield than the control. Gypsum had no significant effect upon the yield of various seed sizes, or upon specific gravity, french fry color, sucrose content, hollow heart or stem-end browning.

All gypsum treatments produced a higher total yield of tubers with little or no scab than the control but the

TABLE 4: MEAN LEAF AND TUBER PERIDERM ANALYSES OF SHEPODY POTATO CULTIVAR AS AFFECTED BY FOUR LEVELS OF GYPSUM

TREATMENT	PLANT PART TESTED	N	%				ppm				
			P	K	Ca	Mg	Zn	B	Cu	Mn	Fe
1. 0 kg/ha Gypsum	Leaf*	4.99	0.45	3.72	1.42	0.63	54	41	33	181	112
	Tuber Periderm	2.02	0.22	2.87	0.07	0.11	16.3	6.8	12	24	138
2. 672 kg/ha Gypsum	Leaf	4.98	0.34	2.79	0.88	0.45	28	29	24	145	78
	Tuber Periderm	1.97	0.23	2.85	0.05	0.10	16	5.3	12	160	166
3. 1344 kg/ha Gypsum	Leaf	5.11	0.34	2.72	0.82	0.42	35	29	25	129	87
	Tuber Periderm	2.04	0.22	2.90	0.06	0.10	16	6	12	26	157
4. 2016 kg/ha Gypsum	Leaf	5.19	0.38	2.93	0.82	0.43	37	31	27	150	86
	Tuber Periderm	2.06	0.24	2.93	0.06	0.10	16	6	12	26	182

* Mid-season for leaf and petiole and tuber periderm of harvest.

TABLE 5: YIELD RESPONSE IN THE SIZE RANGE 30->60mm OF POTATO CULTIVAR SHEPODY WITH STEM-END BROWNING AND HOLLOW HEART AS AFFECTED BY FOUR LEVELS OF GYPSUM APPLICATION

TREATMENT	MEAN YIELD t/ha (30-> 60mm) STEM END BROWNING	HOLLOW HEART
1. 0 kg/ha Gypsum	15.64[A]	Nil
2. 672 kg/ha Gypsum	16.00[A]	Nil
3. 1344 kg/ha Gypsum	14.18[A]	Nil
4. 2016 kg/ha Gypsum	15.29[A]	Nil

TABLE 6: TUBER SPECIFIC GRAVITY, FRENCH FRY COLOR AND SUCROSE CONTENT OF SHEPODY POTATO CULTIVAR AS AFFECTED BY FOUR LEVELS OF GYPSUM APPLICATION

TREATMENT	MEAN TUBER SPECIFIC GRAVITY	MEAN FRENCH FRY COLOR-MEAN USDA EQUIVALENT*	MEAN SUCROSE CONTENT-mg/g
1. 0 kg/ha Gypsum	1.064	1.18	1.98
2. 672 kg/ha Gypsum	1.064	1.13	1.90
3. 1344 kg/ha Gypsum	1.064	1.15	1.99
4. 2016 kg/ha Gypsum	1.064	1.10	2.08

672 kg/ha treatment was significantly better than the control. Tuber periderm Ca% was unaffected by the treatment, and this seems to be the case for soils which test high in Ca. Leaflet %Ca was also unaffected by the gypsum treatments.

These studies will continue for 2 more years.

ACKNOWLEDGEMENTS: The authors respectfully acknowledge the work of D. McIsaac for carrying out specific gravity and other tuber analyses needed.

REFERENCES:

1. Anderson, N.A., and J.M. Lorang, 1988. Potato Scab: An old disease presents new control opportunities. Valley Potato Grower. December, 1988. p.14.

2. Davis, J.R., McDole, R.E., and R.M. Callihan. 1976. Fertilizer effects on common scab of potato and the relation of calcium and phosphate - phosphorus. Phytopathology 66: 1236 - 1241.

3. Davis, J.R., Garner, J.G., and R.M. Callihan. 1974. Effects of Gypsum, Sulphur, Temaclor, and Terraclor Super-X for Potato Scab Control. Am. Pot. J. 51: 35-43.

4. Kellman, A., McGuire, R.G., and K.C. Tzeng. 1989 in Management of Diseases by Micro and Macroelements, Engelhard, A.W. ed. pp 102-123.

5. Simmons, K.F., and K.A. Kelling. 1987. Potato Responses to Calcium Application on Several Soil Types. Am. Pot. J. 64: 119-136.

RESPONSE OF RUSSET BURBANK POTATO CULTIVAR TO DIFFERENT CALCIUM TREATMENTS

R.P. Hinds and G. Pelletier

ABSTRACT: Different calcium carriers were applied on the Holmesville soil series (pH 5.5-5.8) to a crop of Russet Burbank potato cultivar. The treatments were N-hib Ca in a single application (59 kg/ha N + 40 kg/ha Ca); N-hib Ca in a split application (59 kg/ha N + 40 kg/ha Ca); gypsum 672 kg/ha; Cal-U-Sol 168 kg/ha (34 kg/ha Ca + 17 kg/ha S + 8 kg/ha Mg) and a control where no calcium was applied. Total yield, and the undersized tubers were unaffected by the calcium treatments. Cal-U-Sol produced significantly less off-type tubers compared to gypsum or N-hib Ca, but was not better than the control. Cal-U-Sol and the control produced a significantly higher yield of marketable tubers than N-hib Ca applied once and gypsum.

None of the calcium treatments had any significant effect upon specific gravity, tuber periderm % Ca, french fry color or sucrose content. The method of periderm removal and the sample amount may have affected tuber periderm values observed. However, tuber periderm % Ca was increased in all treatments except the control. Claims that N-hib Ca would increase yield, P, K and Mg uptake in plant tissue were not in evidence. Cal-U-Sol treatments had a lower leaf % N at mid-season than other treatments and paled towards the end of the season. These studies will continue for two more years.

RÉACTION DE CULTIVARS DE POMMES DE TERRE RUSSET BURBANK À DIVERS TRAITEMENTS AU CALCIUM

Résumé: Divers produits comprenant du calcium ont été appliqués à des cultivars de pommes de terre Russet Burbank cultivés dans des sols de type Holmesville (pH de 5,5 à 5,8). Les traitements ont consisté en une application simple de N-hib-calcium (59 kg d'azote et 40 kg de calcium par hectare), une application combinée de N-hib-calcium (59 kg d'azote et 40 kg de calcium par hectare), une application de gypse (672 kg/ha), une application de 168 kg de Cal-U-sol par hectare (34 kg de Ca par hectare + 17 kg de S par hectare + 8 kg de Mg par hectare), et aucun traitement n'a été appliqué sur une parcelle témoin. Le rendement total et le nombre de tubercules trop petits n'ont pas été modifiés par les traitements au calcium. On comptait moins de tubercules hors type dans les parcelles traitées avec du Cal-U-Sol que dans celles traitées avec le gypse ou le N-hib-calcium, mais les résultats n'étaient pas meilleurs que celui obtenu dans la parcelle témoin. Les parcelles traitées avec du Cal-U-Sol et les parcelles témoins ont donné un rendement beaucoup plus élevé de tubercules commercialisables que celles ayant subi un traitement de N-hib-calcium en application simple et de gypse.

Aucun des traitements au calcium n'a eu d'effet notable sur la densité relative, la teneur en calcium de la pelure, la couleur des frites ou le taux de sucrose. La méthode utilisée pour peler les tubercules et la quantité de pelure analysée peuvent avoir une incidence sur les taux de calcium observés. Toutefois, la teneur en calcium de la pelure a augmenté dans toutes les parcelles traitées et non dans la parcelle témoin. On n'a pas pu démontrer que le N-hib-calcium pouvait augmenter le rendement et la capacité d'absorption de P, K et Mg dans les tissus des plantes. Les traitements au Cal-U-Sol ont diminué plus que les autres traitements la teneur en azote des feuilles à la mi-saison, et leur efficacité diminuait vers la fin de la saison. Ces études se poursuivront pendant deux autres années.

INTRODUCTION: The importance of calcium (Ca) in the production of peanuts has been well documented and it is only in recent years that attention has been focused on Ca nutrition in potato tuber health and development. Several researchers have shown the importance of high Ca concentration in the potato tuber to be necessary to reduce bacterial soft rots (Engelhard, 1989). Problems with Ca deficiency in potatoes are localized in the tuber and not the foliage. This is the result of several factors. Firstly, Ca is taken up by the roots and moves exclusively through the xylem to the leaves - the tubers are by-passed. Secondly, Ca in the leaves does not move

back down to the tubers as movement of Ca in phloem is minimal. Thirdly, tubers and stolons must take up needed Ca directly from the soil through their unsuberised tips. As a result, proper Ca nutrition of tubers requires stolons and tubers to be immediately surrounded by high levels of calcium.

Thorne (1989) reported that Internal Brown Spot (IBS), a disorder in tubers prevalent under conditions of intense summer temperature changes and rapid vine growth, is the result of inadequate Ca nutrition. It is postulated that since the foliage of potato plants compete for Ca with the tuber, under rapid vine growth and rapid moisture withdrawal, Ca may actually be pulled away from the tuber resulting in IBS. Liquid calcium ammonium nitrate 17 (CAN 17 - 8% Ca; 11.6% nitrate N), supplying 25 lbs/ac of Ca was found to be as effective for increasing Ca content of the potato tuber periderm as 225 lbs/ac of calcium supplied through 1125 lbs of gypsum; and thus reducing IBS. Indeed, Ca% in the tuber periderm has been shown to be a good indicator of Ca content of the tuber itself. Engelhard (1989) reported ranges of Ca in the tuber periderm to be 0.057-0.277%.

Simmons et al (1988) have shown that gypsum (pelleted, sieved or granulated) applied broadcast, sidedressed or in a preplant strip is an excellent source of Ca and effective in increasing tuber periderm Ca concentration. Stoller (1989) in setting up a model for Ca as the "second messenger", stated that Ca will move into the tuber, only if the tuber loses water, and further that when potatoes are heavily watered, tubers closer to the soil surface will often have fewer Ca related problems, because they lose more moisture.

Stoller (1989), in recognizing that Ca allows the crop to use more ammonium nitrogen, introduced a product called N-hib Calcium - a calcium/urea formulation (12% N; 8% Ca) for use in potatoes and other crops. Increased yields, increased tuber periderm % Ca, increased phosphate in petioles, increased K and Mg in tissues, better quality and higher specific gravity have all been associated with the use of the product, (Stoller, 1989). With all this increasing emphasis on Ca and potato yields it was decided to examine several calcium supplying products over the next 2 years to observe their effects on potato yield and quality and tuber periderm % Ca. It was decided to examine the following products:

- N-hib Calcium - 12% N; 8% Ca.
- Gypsum - 22% Ca; 16% S.
- Cal-U-Sol - 20% Ca; 10% S and 4.5% Mg.

METHODS: Cut seed (60g approximately) of Russet Burbank

was planted on the Holmesville clay loam soil series (pH 5.5) on May 26, 1989. Rotation in the field was potatoes, peas, winter rye, potatoes. A RCBD was employed and the following treatments were imposed:

Treatments

1. Basic fertilizer application - 1232 kg/ha 15-15-15 banded at planting with no calcium.

2. Basic fertilizer application - 1232 kg/ha 10-15-15 banded at planting plus 393 L/ha N-hib Ca (12% N, 8% Ca) in applications side-dressed on June 23 and July 12.

   - Density of N-hib Ca 5.76 kg/4.5 L.

3. Basic fertilizer application - 1232 kg/ha 10-15-15 banded at planting plus 393 L/ha N-hib Ca (12% N, 8% Ca) in a single application on June 23.

4. Basic fertilizer application - 1232 kg/ha 15-15-15 banded at planting plus 672 kg/ha of gypsum (22% Ca, 16% S) top-dressed post-planting on May 29.

5. Basic fertilizer application - 1232 kg/ha 15-15-15 banded at planting plus 168 kg/ha Cal-U-Sol (20% Ca, 10% S, 4.5% Mg) mixed in with the fertilizer.

The crop was harvested on October 9. Soil and leaf analyses were taken at mid-season. Tuber periderm %Ca was determined by peeling tubers with a carrot peeler. Rainfall in July, during tuber initiation and early tuber development was 50% of normal.

RESULTS AND DISCUSSION: Yields: Table 1 shows the yield of the Russet Burbank cultivar with different calcium treatments. All the treatments including the control gave an excellent yield. The treatments had no significant effect upon total yield, though the N-hib Ca applied in a split application gave the highest total yield. Cal-U-Sol produced significantly less off-type tubers than the N-hib Ca and gypsum treatments, but no different from the control. For marketable yield, Cal-U-Sol and the control produced significantly better yield than the N-hib Ca applied once and gypsum. This is interesting because Cal-U-Sol treatments became pale yellow and clearly were senescing earlier than the other treatments. It has been noted over the years that potato crops that run out of N and pale towards the end of the season raise only the concern of the viewer, but have been known to produce good marketable yields.

TABLE 1: EFFECT OF DIFFERENT CALCIUM TREATMENTS ON YIELD OF RUSSET BURBANK POTATO CULTIVAR

Treatment	Yield t/ha			
	Undersized (<84g)	Marketable yield 84 - >283g	Off Type	Total
1. No calcium	8.14	32.61^{ABC}	6.28^{AB}	47.04^{A}
2. N-hib Ca-split appl. 393 L/ha	7.30	33.78^{AB}	7.08^{A}	48.15^{A}
3. N-hib Ca-single appl. 393 L/ha	6.96	30.58^{C}	7.37^{A}	44.91^{A}
4. Gypsum - 672 kg/ha	7.56	31.40^{BC}	6.37^{A}	45.33^{A}
5. Cal-U-Sol-168 kg/ha	7.13	35.27^{A}	4.47^{B}	46.87^{A}

Duncan's Multiple Range Test - 0.05 level. Means with the same letter are not significantly different from each other in the same group.

Soil Analyses: Table 2 shows the mean soil analyses prior to planting (brackets) and 8 weeks post application. There was a noted decrease in pH in all the treatments including the control. The yields in all the treatments were so good that a pH decline, and a reduction in soil K is understandable.

TABLE 2: MEAN SOIL ANALYSIS OF DIFFERENT CALCIUM TREATMENTS PRIOR TO PLANTING (BRACKETS) AND 8 WEEKS POST APPLICATION

Treatment	Soil Analyses					
	pH	O.M. %	kg/ha P_2O_5	K_2O	Ca	Mg
1. No calcium	5.1	2.7	513+	328	1317	182
	(5.7)	---	(513+)	(200)	(1100)	(110)
2. N-hib Ca-split application	5.5	2.4	513+	430	885	98
	(5.8)	---	(513+)	(186)	(1103)	(119)
3. N-hib Ca-single application	5.1	2.7	513+	323	1443	177
	(5.5)	---	(513+)	(276)	(1109)	(154)
4. Gypsum - 672 kg/ha	5.2	2.6	513+	407	1231	119
	(5.7)	---	(513+)	(200)	(1121)	(110)
5. Ca.-U-Sol - 168 kg/ha	4.7	2.5	513+	246	995	102
	(5.5)	---	(513+)	(166)	(1103)	(154)

Specific Gravity, Sucrose Content, French Fry Color and Tuber Periderm % Ca: Table 3 shows the data for the effect of the various calcium treatments on specific gravity, sucrose content, french fry color and tuber periderm % Ca. None of the treatments had any significant effect upon specific gravity, sucrose content, french fry color or tuber periderm % Ca. However, all the calcium treatments increased tuber periderm % Ca over the control.

TABLE 3: EFFECT OF DIFFERENT CA TREATMENTS ON SPECIFIC GRAVITY, SUCROSE CONTENT, FRENCH FRY COLOR AND TUBER PERIDERM %CA OF RUSSET BURBANK

Treatment	Specific Gravity	Sucrose Content mg/g	French Fry Color	Tuber Periderm % Ca
1. No calcium	1.077	1.28	4.5	0.03[A]
2. N-hib Ca-split application	1.073	1.52	4.4	0.05[A]
3. N-hib Ca - single application	1.075	1.44	4.0	0.05[A]
4. Gypsum-672 kg/ha	1.078	1.54	4.0	0.05[A]
5. Cal-U-Sol 168 kg/ha	1.074	1.49	4.5	0.05[A]

Duncan's Multiple Range Test - 0.05 level. Means with the same letter are not significantly different from each other.

Leaf and Tuber Periderm Analyses: Table 4 shows data in relation to leaf and petiole and tuber periderm % Ca for all the treatments. As noted before all the calcium treatments increased tuber periderm % Ca though not significantly over the control. Cal-U-Sol had some effect upon N content of the leaf as this was 5.50% compared to over 6.0% for the control and the other treatments. Towards the end of the season Cal-U-Sol treatments were paler than the others, but this is not necessarily a bad feature prior to harvest. Other than tuber periderm % Ca, claims that phosphate levels, K levels, Mg levels and yields will be increased by some of these products were not apparent. Over the next two years further observations on these parameters will be carried out.

TABLE 4: MEAN LEAF AND PETIOLE AND TUBER PERIDERM ANALYSES ON RUSSET BURBANK POTATO CULTIVAR AS AFFECTED BY DIFFERENT CALCIUM TREATMENTS

TREATMENT	PLANT PART	% N	% P	% K	ppm Ca	ppm Mg	ppm Zn	ppm B	ppm Cu	ppm Mn	ppm Fe
					TESTED						
1. No calcium	Leaf*	6.20	0.60	3.47	0.51	0.37	39	10	18	174	106
	Tuber Periderm	**2.12**	**0.25**	**2.90**	**0.03**	**0.10**	**24**	**5**	**11**	**22**	**203**
2. N-Hib Ca-split applic.	Leaf	6.00	0.45	3.59	0.69	0.40	36	12	17	219	102
	Tuber Periderm	**2.26**	**0.23**	**2.95**	**0.05**	**0.09**	**25**	**6**	**12**	**30**	**198**
3. N-Hib Ca-single applic.	Leaf	6.00	0.50	3.80	0.56	0.33	37	12	18	190	104
	Tuber Periderm	**2.24**	**0.24**	**2.92**	**0.05**	**0.10**	**26**	**5**	**12**	**30**	**233**
4. Gypsum 672 kg/ha	Leaf	6.20	0.59	3.37	0.53	0.40	39	12	19	151	101
	Tuber Periderm	**2.16**	**0.24**	**2.74**	**0.05**	**0.10**	**24**	**5**	**11**	**18**	**172**
5. Cal-U-Sol 168 kg/ha	Leaf	5.50	0.47	3.76	0.59	0.34	50	15	18	234	113
	Tuber Periderm	**2.00**	**0.22**	**2.99**	**0.05**	**0.10**	**22**	**5**	**10**	**30**	**217**

* Leaf and Petiole at mid-season.
Tuber periderm after harvest.

Costs of Application: The approximate cost of application of N-hib Ca twice was $202/ha; for N-hib Ca once was $101/ha; for gypsum it was $44/ha and for Cal-U-Sol it was $86/ha and for the control $0/ha.

CONCLUSION: None of the calcium treatments had any significant effect upon total yield, or undersized (smalls) tubers. Cal-U-Sol produced significantly less off-type tubers compared to N-hib Ca or gypsum but was not better than the control. Cal-U-Sol and the control plots produced a significantly higher yield of marketable

tubers than the N-hib Ca applied once and gypsum. None of the treatments had any significant effect upon specific gravity, tuber periderm % Ca, french fry color or sucrose content. All the calcium treatments increased tuber periderm Ca% equally as compared to the control. Cal-U-Sol treatments all paled towards the end of the growing season and leaf N% was lower at mid-season compared to other treatments including the control.

Costs of the N-hib Ca and Cal-U-Sol treatments exceed $86/ha and no significant increase in total yield was observed over the control or gypsum treatment which cost $44/ha. Based on 1989 date, there can hardly be any justification for applying these expensive products, but firm conclusions will be drawn over the next two years.

ACKNOWLEDGEMENTS: The authors respectfully acknowledge the work of M. Michaud during the period of the project.

REFERENCES:

1. Englehard, A.W., ed. 1989. Management of Diseases with macro and microelements, APS Press. pp 102-123; 152-166.

2. Simmons, K.E., Kelling, K.A., Wolkowski, R.P., and A. Kelman. 1988. Effect of calcium source and application method on potato yield and cation composition. Agron. J. 80: 13-21.

3. Thorne, T., 1989. Internal Brown Spot can be controlled. Pot. Grower of Id. May 1989. pp 28-29.

4. Stoller, J.H., 1989. Proper use of calcium improves potato quality. Pot. Grower of Id. Jan. 1989. pp 30-31.

PRELIMINARY OBSERVATIONS ON YIELD AND SCAB INCIDENCE OF YUKON GOLD POTATO CULTIVAR AS AFFECTED BY GYPSUM/GREEN MANURE TREATMENTS

R.P. Hinds and A.F. Perley

ABSTRACT: Yukon Gold potatoes (scab-susceptible) were planted on the Holmesville clay loam soil series (pH 5.0-5.6) naturally infested with common scab Streptomyces scabies. Two gypsum applications (672 and 0 kg/ha) were made to a previous green manure of timothy and red clover. Observations indicate that total and marketable yield were not affected by gypsum. The high level of weed infestation was responsible for about 30% decrease in yields. The incidence of scab was higher on the red clover treatments than on the timothy and was higher where weed infestation was greatest. Total and marketable yield was also higher on the clover side than on the timothy side. Leaf plus petiole Ca% was higher under the gypsum treatments but tuber periderm % Ca indicated no consistent pattern. The method of periderm removal and sample amount for analysis may have influenced readings observed. Specific gravity was better and sucrose content was lower under gypsum applications. These preliminary observations will form the basis for a three year study of cultural practices and gypsum on yield and incidence of scab in Shepody.

OBSERVATIONS PRÉLIMINAIRES SUR LE RENDEMENT DE CULTIVARS DE POMMES DE TERRE YUKON ET SUR LA FRÉQUENCE DES CAS DE GALE À LA SUITE DE TRAITEMENTS AU GYPSE ET À L'ENGRAIS VERT

Résumé: Des pommes de terre Yukon Gold (sensibles à la gale) ont été plantées dans des sols de type Holmesville formés de loam argileux (pH variant de 5 à 5,6) naturellement infestés par la gale commune Streptomyces scabies. Des applications de gypse ont été faites à raison de 0 et 672 kg/ha dans une parcelle traitée avec un engrais vert composé de fléole et dans une parcelle traitée avec un engrais vert composé de trèfle violet. Les observations indiquent que le rendement total et le rendement de tubercules commercialisables n'ont pas varié par suite de l'application de gypse. Cependant, les mauvaises herbes étaient responsables d'environ 30 % de la baisse de rendement. La fréquence des cas de gale était plus grande sur la parcelle traitée avec le trèfle violet que sur celle traitée avec la fléole, ainsi qu'aux endroits où l'infestation par les mauvaises herbes était plus grande. Le rendement total et le rendement de tubercules commercialisables étaient également plus élevés sur la parcelle où avait poussé le trèfle que sur celle où avait poussé la fléole. La teneur en calcium des feuilles et des pétioles était plus élevée dans les parcelles traitées avec du gypse, mais on n'a pu discerner de modification constante de la teneur en calcium de la pelure. La méthode utilisée pour peler les tubercules et la quantité de pelure analysée ont pu avoir une incidence sur les résultats obtenus. La densité relative était plus grande et le taux de sucrose plus faible dans les pommes de terre traitées avec du gypse. Ces observations préliminaires serviront de base à une étude de trois ans concernant les effets des pratiques culturales et du gypse sur le rendement et la présence de la gale dans la pomme de terre Shepody.

INTRODUCTION: Common scab of potato, when severe, can severely reduce the quality of an otherwise good marketable crop. According to Bergey's Manual of Determinative Bacteriology, the taxonomic position of the causal agent Streptomyces scabies is still uncertain, but for purposes of this discussion, the pathogen is being referred to as a gram positive filamentous bacterium (Anderson and Lorang, 1988).

Information about plant nutrients in relation to potato scab has been limited in general, to macro and micronutrients, nutrient concentration in soil and infrequently nutrient concentration in potato tubers. Much of the literature on potato scab control deals with the application of nutrients to the soil which also

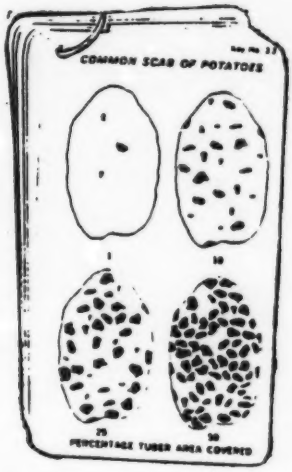
affect soil pH. Under field conditions, disease incidence occurs over a range of pH, from very low 4.5 to over 8.0. But while disease incidence and severity may be pH related, high soil moisture has been shown, regardless of pH, to reduce scab (Hammerschmidt et al, 1989). Gypsum and elemental sulphur have been shown to reduce scab incidence. In addition to plant nutrients to manage scab, other control methods include seed treatments (pentachloronitrobenzine PCNB), crop rotations, green manures, irrigation timing and varietal resistance (Engelhard ed: 1989, Anderson and Lorang, 1988).

Since S. scabies is ubiquitous and so well adapted, many workers feel no single control strategy will provide total disease control. Indeed elimination of scab may be both unfeasible and unnecessary, since growers, processors and consumers are willing to tolerate some blemishes on tubers. As a result, a three year effort is being designed to examine the combined effects of a green manure with gypsum, under rain-fed production in NB, in an effort to determine the degree of scab control in scab-susceptible commercial varieties on soils with long histories of the disease. This study represents only a preliminary look at the possible outcomes and will serve as a basis for work to be enjoined and continued.
MATERIALS AND METHODS: One section of a field on the Holmesville clay loam soil series was planted in 1988 to red clover and the other section to timothy. Both crops were moldbord plowed (i.e. plowed down green) in the spring of 1989 and planted to a scab-susceptible potato cultivar, Yukon Gold. Each of the previously planted green manures, after planting with Yukon Gold, was divided into two, and one portion was treated with 672 kg/ha gypsum and the other portion received no gyspum in the manner shown below.

(previously) Timothy		(previously) Red Clover	
no gypsum	672 kg/ha gypsum	672 kg/ha gypsum	no gypsum
Yukon Gold		Yukon Gold	

These observation plots were monitored for pH, O.M.% and other soil nutrients before and 8 weeks post-planting. Leaf analyses were carried out at mid-season. Tuber periderm was removed by a carrot peeler for analysis. Yield, U.S.D.A. color, specific gravity, rainfall and dry

matter additions from the green manure crops were noted. Scab incidence and severity were determiined on the basis of the percentage of tuber area covered with scab lesions and indicated in the key below (Can. Plant Dis. Surv: 51, 1971).



The potato crop was planted on June 3, and harvested September 19, 1989. Fertilization was at the rate of 135 kg/ha each of N, P and K. Source of N was ammonium nitrate. Rainfall recorded was 50% of normal for the month of July.

RESULTS AND DISCUSSION: Growth and Yield: Observations on yield response of Yukon Gold potato cultivar at two levels of gypsum feritlization to prior green manure treatments are given in Table 1 and Table 2.

TABLE 1: YIELD RESPONSE OF YUKON GOLD CULTIVAR AT TWO LEVELS OF GYPSUM FERTILIZATION TO PRIOR GREEN MANURE TREATMENTS

Treatment		Mean Yield - t/ha			
Prior Green Manure Treatment-Dry Matter Added t/ha	Gypsum* Applied	Sizes <30 mm	30-60 mm	>60mm	Total
1. Timothy-9.75 t/ha D.M.	672 kg/ha	0.82	6.91	14.63	22.36
2. Timothy-9.75 t/ha D.M.	0 kg/ha	1.62	11.38	9.76	22.76
3. Red Clover-5.05 t/ha D.M.	672 kg/ha	1.22	10.57	14.22	26.01
4. Red Clover-5.05 t/ha D.M.	0 kg/ha	1.52	9.76	17.48	28.87

* Gypsum - 22% Ca; 16% S.

TABLE 2: MARKETABLE YIELD IN RELATION TO SOIL pH, CALCIUM CONTENT OF SOIL, LEAF & PETIOLE AND TUBER PERIDERM OF YUKON GOLD POTATO CULTIVAR AT TWO LEVELS OF GYPSUM FERTILIZATION TO PRIOR GREEN MANURE TREATMENTS

Treatment	Mkt Yld t/ha	pH 8 wks post planting	Calcium* content of soil kg/ha	Calcium content of leaf &petiole %	Calcium content of tuber periderm %
1. Timothy/672 kg/ha Gypsum	21.54	5.4	1173	0.87	0.05
2. Timothy/0 kg/ha Gypsum	21.14	5.6	1782	0.78	0.06
3. Red Clover/672 kg/ha Gypsum	24.79	5.2	1520	0.93	0.04
4. Red Clover/0 kg/ha Gypsum	27.24	5.0	1256	0.87	0.03

* Values are medium for NB Soils

Overall growth and yield of Yukon Gold was poor as a result of weed infestation. The predominant weed was lamb's quarters (Chenopodium album L.) and there was slightly more weeds on the timothy side of the plots than on the red clover side. Observations of yields in areas where there were little or no weeds, showed that yields were 30% greater than the weedy sections of the treatments.

Gypsum had no great effect upon total or marketable yield but the degree of weed infestation may have conpounded this as previous work (Hinds, 1982) has shown gypsum to have positive effects upon both total and marketable yield in NB. Simmons and Kelling (1987) also reported that on low-Ca soils, gypsum (1680 kg/ha) while it did affect total yield, improved tuber grade and/or marketable yield.

The red clover side of the field produced a higher total and marketable yield than the timothy side. It is uncertain what role, if any, the amount of dry matter addition played in this issue since leaf and petiole N in all treatments were similar (Table 6). Simmons and Kelling (1987), on low-Ca soils where gypsum improved tuber grade and marketable yield, showed these improvements were accompanied by increased periderm Ca concentrations but leaflet Ca concentrations were unaffected. It was also reported that on higher test Ca-soils, responses were inconsistent and tuber periderm Ca was generally not increased. On these observation plots, the soil was medium-Ca tested and yield was slightly higher with lower tuber periderm Ca% and higher leaf & petiole Ca%. These observations will be followed up further in future trials.

Yield and Scab Incidence: The literature is replete with work indicating that the incidence of scab is reduced through the addition of gypsum and sulfur (David et al, 1974), green manures, crop rotations (Anderson and Lorang, 1988) and green manures and irrigation (Hammerschmidt et al, 1989). Observations to indicate the incidence of scab in Yukon Gold potato cultivar at two levels of gypsum to prior green manure treatments are given in Table 3.

TABLE 3: SCAB INCIDENCE OF YUKON GOLD POTATO CULTIVAR AT TWO LEVELS OF GYPSUM FERTILIZATION TO PRIOR GREEN MANURE TREATMENTS

Treatment		Yield t/ha	
Prior Green Manure Treatment-Dry Matter Applied t/ha	Gypsum Applied	Tuber Area% Covered With Scab Lesions	
		0-10 %	>10%
1. Timothy - 9.75 t/ha D.M.	672 kg/ha	20.5 (92%)*	1.86 (8%)
2. Timothy - 9.75 t/ha D.M.	0 kg/ha	22.76 (100%)	0.00 (0%)
3. Red Clover-5.05 t/ha D.M.	672 kg/ha	20.80 (80%)	5.21 (20%)
4. Red Clover-5.05 t/ha D.M.	0 kg/ha	23.67 (82%)	5.20 (18%)

* Brackets - % of total yield.

Table 3 shows the yield (t/ha) of tubers whose tuber surface area was covered from 0-10% with scab lesions and also greater than 10%. Gypsum together with the green manure did not affect scab incidence and this may be attributed to the high intensity of weeds. It was observed that the greater the weed coverage, the greater the scab incidence, regardless of treatment. Even though there was less weeds on the red clover side, the yield of tubers with a high incidence of scab was greater on the red clover side than the timothy side. Hammerschmidt et al (1989) reported red clover significantly increased scab in their work and also high soil moisture (through irrigation and rainfall) decreased scab incidence. During the period of tuber initiation and growth, rainfall was 50% of normal and together with the weed infestation, moisture was limiting and may have worsened the scab situation. Tubers removed from among the densest weeds were 100% covered with scab lesions.

Specific Gravity, French Fry Color and Sucrose Content: Table 4 shows the specific gravity, french fry color and sucrose content as affected by the gypsum/green manure treatments. Gypsum produced a slightly better specific gravity and lower sucrose content than where no gypsum was applied. The red clover side produced better specific gravity and lower sucrose content than the timothy side.

TABLE 4: SPECIFIC GRAVITY, FRENCH FRY COLOR AND SUCROSE CONTENT OF YUKON GOLD AS AFFECTED BY TWO LEVELS OF GYPSUM TO PRIOR GREEN MANURE TREATMENTS

TREATMENT	SPECIFIC GRAVITY	FRENCH FRY COLOR MEAN U.S.D.A. EQUIVALENT*	MEAN SUCROSE CONTENT - mg/g
1. Timothy/672 kg/ha Gypsum	1.079	1.0	1.88
2. Timothy/0 kg/ha Gypsum	1.066	1.0	2.37
3. Red Clover/672 kg/ha Gypsum	1.077	1.0	0.82
4. Red Clover/0 kg/ha Gypsum	1.076	1.0	1.14

* U.S.D.A. color of 1-4 is acceptable. Higher numbers correspond to a worsening of color.

Soil, Leaf & Petiole and Tuber Periderm Analyses: Table 5 and 6 show mean soil, leaf plus petiole and tuber periderm analyses for the gypsum/green manure treatments. The red clover side of the field had a lower pH but higher organic matter at 8 weeks post-planting, and produced higher scab incidence but higher yield that the timothy side. Leaf and petiole Ca% was higher on the gypsum treated plots than where no gypsum was applied and was higher on the clover side than on the timothy side. Tuber periderm Ca% was generally not increased by the gypsum and this may be due to the medium test Ca-level of the soil under treatment and also the method of removal of the periderm and the sample amount used in the analysis. The range of tuber periderm Ca% is generally from 0.057 to 0.277% on a dry weight basis. Tuber periderm %Ca was lower on the red clover side where there was more scab than on the timothy side. Davis et al (1974) has associated reduced scab with lower Ca% in the tuber periderm and also low soil moisture, which increases scab, results in higher Ca concentrations in tuber periderm. Tuber periderm Ca% was lower than normal in the tuber periderm even though there was a drought during tuber initiation and development in this preliminary work.

TABLE 5: MEAN SOIL ANALYSIS RESULTS OF GREEN MANURE/ GYSPUM TREATED PLOTS OF YUKON GOLD POTATO CULTIVAR - 8 WEEKS POST GYPSUM TREATMENT

TREATMENT PRIOR GREEN MANURE TREATMENT-DRY MATTER APPL.t/ha	GYPSUM APPLIED	pH	O.M. %	P_2O_5 kg/ha	K_2O kg/ha	Ca kg/ha	Mg kg/ha
1. Timothy-9.75 t/ha D.M.	672 kg/ha	5.4	2.8	513+	430+	1173	122
2. Timothy-9.75 t/ha D.M.	0 kg/ha	5.6	3.0	513+	430+	1782	142
3. Red Clover-5.05 t/ha D.M.	672 kg/ha	5.2	3.1	513+	430+	1520	120
4. Red Clover-5.05 t/ha D.M.	0 kg/ha	5.0	3.1	513+	430+	1256	111

TABLE 6: MEAN LEAF AND TUBER PERIDERM ANALYSES OF SHEPODY POTATO CULTIVAR AS AFFECTED BY FOUR LEVELS OF GYPSUM

TREATMENT	PLANT PART TESTED	% N	% P	% K	% Ca	% Mg	ppm Zn	ppm B	ppm Cu	ppm Mn	ppm Fe
1. Timothy 672 kg/ha Gypsum	Leaf*	5.26	0.38	3.10	0.87	0.32	24	29	16	91	100
	Tuber Periderm	1.85	0.21	2.78	0.05	0.10	14	8	5	30	256
2. Timothy 0 kg/ha Gypsum	Leaf	5.29	0.40	3.14	0.78	0.31	27	25	16	105	89
	Tuber Periderm	1.78	0.22	3.33	0.06	0.12	14	9	6	13	187
3. Red Clover 672 kg/ha Gypsum	Leaf	5.25	0.40	3.26	0.93	0.35	42	26	16	101	78
	Tuber Periderm	1.72	0.18	2.66	0.04	0.10	14	8	5	19	226
4. Red Clover 0 kg/ha Gypsum	Leaf	5.17	0.38	3.24	0.87	0.36	30	26	16	82	73
	Tuber Periderm	1.65	0.18	2.68	0.03	0.09	12	8	4	18	212

* Mid-season for leaf and petiole tuber periderm at harvest.

CONCLUSIONS: Preliminary observations of gypsum applications to prior green manure treatments on the medium Ca-test Holmesville clay loam soil series (naturally infested with Streptomyces scabies) indicate that total and marketable yield was unaffected by the gypsum applications. A high level of weed infestation may have been responsible for this and the low yields in general, by creating a more droughty effect than would otherwise have been the case. The red clover side produced higher yields than the timothy side but also produced higher incidence of scab than the timothy side. Weed infestation reduced yields by 30% and scab incidence in Yukon Gold was greatest in the more weedy sections of the treatments regardless of gypsum.

Gypsum produced slightly better specific gravity and lower sucrose than the untreated gypsum plots. Tuber periderm %Ca was not increased with applied gypsum probably because of the medium Ca-test level of the soil, the periderm removal method and the sample amount used for analysis. This work was the basis of future work on several green manure/gypsum trials to be looked at over the next three years.

REFERENCES:

1. Anderson, N.A., and Lorang, J.M. 1988. Potato Scab: An old disease presents new control opportunities. Valley Pot. Grower. December, 1988. p.14.

2. Davis, J.R., Garner, J.G., and R.M. Callihan. 1974. Effects of gypsum, sulphur, terraclor and terrador Super -X for potato scab control. Am. Pot. J. 51: 35-43.

3. Engelhard, A.W. ed. 1989. Management of Diseases with Macro and Microelements. pp. 102-123, 152-166.

4. Hammerschmidt, R., Vitosh, M.L., Hanson, L.E., and M.L. Zacy. 1989. Effect of Cultural Practices on Incidence of Common Scab (Streptomyces scabies) of Potato. Am. Pot. J. 66: p. 524.

5. Hinds, R.P. 1983. Gypsum/Limestone effects upon yield of potatoes. Pot. Prod. Reports. Pot. Div. NBDA.

6. Simmons, K.F., and K.A. Kelling. 1987. Potato Responses to Calcium Application on Several Soil Types. Am. Pot. J. 64: 119-136.